



HFIDTC Educational Requirements - Future Trends in Deployments and Technologies

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Executive Summary

The principle objective of this work was to investigate the impact that future trends in technology and deployment scenarios have on the educational requirements of future military personnel. This report is part of a wider study that focuses on identifying HF problems specific to the selection, education and training of the person rather than interfaces with equipment.

Education and training requirements can be established, by comparing the future work demands against the level of education and the physical and cognitive skills of currently serving military personnel. The gaps between the future skills demands and current educational capabilities are the emerging education and training requirements.

This report investigates the future operational context or conflict scenarios. These scenarios consist of a global context, conflict drivers and the nature or mechanism of operations chosen to deal with the conflict. Once these scenarios and the type of person is known the potential HF can then be derived.

HF issues are identified by investigating the person's tasks and goals in relation to their physical and cognitive capabilities in the context in which the tasks are carried out. HF issues are specific to the people, situations, equipment and scenarios in which humans are found participating.

This report dealt with the high-level tasks, missions and goals that future service people are likely to encounter. Future research is needed to drill down to a lower level of detail in order to pull out the specific education and training needs. It is suggested that future work should build on the scenarios sketched out in this report. For each scenario further detail on the future users and the specific tasks that are required for the given scenario should be established. Future operational requirements can be derived by investigating specific tasks needed to carry out future missions against specific job roles in the army, navy and air force. The skills and educational attainment of current personnel can also be compared against these operational requirements. The training gap is the skills gap between current capability and the required future operational requirements.

It is recommended that education and training objectives should then be developed based on the identified training gaps. The training methods, media and materials should be selected according to the nature of the skills that must be taught.

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1 Introduction

The principle objective of this work is to investigate the impact that future trends in technology and deployment scenarios have on the educational requirements of future military personnel.

Figure 1 illustrates how future education and training requirements are derived. The potential HF issues that may be encountered by future armed forces personnel form the basis of the approach to identifying education and training requirements. Education and training is one out of many ways that can be used to solve HF issues. Sometimes the problems may be most effectively tackled by changing the equipment, context or task. This report focuses on identifying HF problems specific to the selection, education and training of the person rather than interfaces with equipment.

Education and training requirements can be established, by comparing the future work demands against the level of education and the physical and cognitive skills of currently serving military personnel. The gaps between the future skills demands and current educational capabilities are the emerging education and training requirements. Although both concerned with encouraging the development of new skills and knowledge, education and training are different. Education has a broader definition than training. Training is concerned with the acquisition of new skills, knowledge or expertise for a specific task or job. Education however is less specific, and aims to develop higher order thinking and reasoning skills that can be used to solve problems in a variety of situations.

HF issues are identified by investigating the person's tasks and goals in relation to their physical and cognitive capabilities in the context in which the tasks are carried out. HF issues are specific to the people, situations, equipment and scenarios in which humans are found participating.

In order to find out something about the education, skills and personal characteristics of future personnel it is important to first understand the future operational context or conflict scenarios. From these scenarios, potential HF issues are derived. These scenarios consist of a global context, conflict drivers and the nature or mechanism of operations chosen to deal with the conflict.

The future global context describes the physical and political background from which a dispute or disagreement emerges. The global context does not on its own give rise to the conflict but lies at the heart of the problem. The conflict drivers are the human geographic or social response to the global context. The military nature of operation reflects the strategy taken to alleviate the problem caused by the human response.

Specific conflict scenarios are then constructed. For example, a natural disaster like an earthquake (global factor) may cause people to migrate to another heavily populated area nearby. In this newly overpopulated area, a scarcity for resources may occur (conflict driver). This may lead to conflict between the existing residents and the migrants causing instability in the region. A political decision is then made for UK troops to be deployed to intervene in this area. The justification for this decision depends on the foreign policy of the government of the time but could include humanitarian issues or strategic decision to

protect the excavation or transport of an important resource e.g. oil. These issues drive the type of deployment and the nature of the operation.

Once the conflict scenarios are constructed, specific aspects of individual human requirements can be generated. At a generic level, it is possible to infer that if many of the future conflict scenarios will involve peace keeping and peace sustainment operations in urban environments then HF training issues may include understanding how to achieve the mission goal with minimal human casualties.

The next step is to determine the type of person who is likely to be serving in the armed services in the next 5-15 years. This can be described with some certainty as the future commanders and leaders are likely to be serving in the army, navy and air force currently. The cognitive attributes are unlikely to change significantly in this time scale. However, formal education is influenced by cultural trends which changes more rapidly

Educational achievement is improving in the UK. In 2001, ten year old girls and boys were ranked second and third behind Sweden and the Netherlands and Sweden respectively for reading ability in a comparison of G8 countries [54]. More people are undertaking further and higher education than thirty years ago. Thirty nine percent of 17-18 year olds took A levels in 2001/2002 [52] and record numbers of people are achieving higher grades [53].

The nature of further education has changed. There are closer links with commerce and industry that has lead to the growth of vocational degrees. There is also a demand for lifelong learning and further and higher education programmes reflected in the number of part time and distance learning course that are on offer currently.

Although the methods used to deliver education change with culture, in general the armed services will have a more educated pool of people from which to recruit. However these people also have a broader range of opportunities open to them outside the services. Consequently, the armed services will need to compete harder in order to attract these brighter, more educated people.

In the past the armed services recruited graduates as officers and all others as non commissioned officers. Many of the people who in the past may have fallen into non-commissioned roles are now achieving in higher education. The main dilemma for the recruiters is that the pool of people who are choosing to opt out of education is decreasing. It seems evident that the selection criteria will need to change to reflect the real requirements of the different job within the armed services. This may involve a change to the whole structure of career progression.

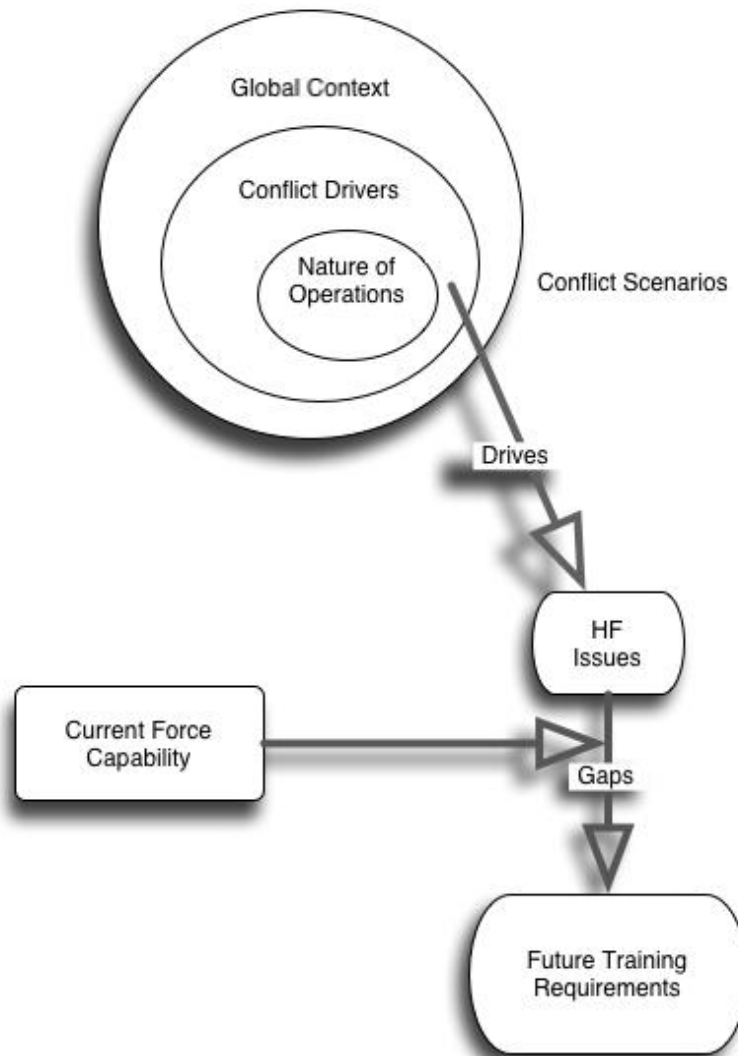


Figure 1: Derivation of Educational Requirements

2 Nature of Future Military Deployments

2.1 Purpose

The purpose of this section is to describe the aspects of future military deployments that could have an influence on future training requirements. This work is sub task 1 of work package 2.1.1, “Education Requirements Analysis for Future Armed Forces” which investigates the underpinning educational requirements of future military personnel.

Describing the nature of future military operations will provide a traceable basis for the identification of training requirements. The future training needs will therefore be driven by the scenarios that arise in the near and long term, assessed in the context of current force skills and capabilities, and new trends in the design and deployment of military equipment (especially equipment supporting battlespace digitization, network enabled capability, and other means of realising mission command strategies).

This section gives an overview of the future context of military operations in the coming 5, 10 and 15 years, based on a literature review, and interviews with subject matter experts (SMEs). Essentially this sub-task establishes the likely problem space in which military operations will work within to realise the current UK government’s foreign policy.

2.2 Scope

This work covers future trends in the political, economic, social and physical environments, along with the military and science and technology dimensions. The literature sources that were reviewed ranged from Government sponsored publications and academic journals and books. The SME’s interviewed included military academics and government advisors, and strategic planners within the MoD.

Special emphasis has been placed on Networked Enabled Capability and specifically the human factors aspects of information exploitation and information management required to achieve increased decision superiority.

This section describes the nature of future military operations in terms of three aspects:

1. Global Context

The physical geographic aspects of the operation

2. Conflict Drivers

The human geographic, or social and political environment that is the root cause of the military operation

3. Nature of Operations

The intent or short-term context and objective of the operation

Taken together, these three elements combine to form a **future deployment scenario** (see Figure 2). These deployment scenarios can be used to project into various points in the future. For the purpose of this report, the projection points are 5, 10 and 15 years into the future. Scenarios can then be constructed from this basis, and the training needs derived from consideration of the human tasks that are associated with the scenarios.



Figure 2: Conflict Scenario Construction

2.3 Method

In accordance with the outline approach developed by Dr Don Harris following the stakeholder meeting held on 19th February 2004 at St Giles Court London, a literature review supported by targeted interviews were carried between 21st and 30th June 2004.

The interviewees included personnel from academia as well as serving military personnel from all three armed services

- Prof Chris Bellamy, The Department of Defence Management and Security Analysis (DDMSA), Security Studies Institute, Cranfield University, Shrivenham
- Lt Col Graeme Olley, The Department of Defence Management and Security Analysis (DDMSA), Security Studies Institute, Cranfield University, Shrivenham
- Cdr Ian Stidson; 2SL/ Naval Training and Education (Strategy), Portsmouth
- Cdr John Perkins; DGTE Strat Plans, Work Package 2 Stakeholder MoD, St Giles Court, London

- Cdr Jim Hammersley (JH); Work Package 2 Stakeholder MoD; St Giles Court, London
- Wg Cdr Steve Gunner, Joint Doctrine and Concepts Centre, Shrivenham

2.4 Global Context

Areas of Instability

The results of Interviews with SME's and the literature review suggest that certain areas of current instability, such as Eastern Europe, may move into a more stable period over the next 10 years. Current UK operations in this region, characterised by 'peace sustainment' mission objectives, support this projection.

The SME interviews suggested that, looking into the 5-10 year time frame, the Horn of Africa and the surrounding area would be a potential area of conflict that may involve the assistance of UK forces. This assertion is supported by references to instability in this region on the BBC news [39, 41] and UN affiliated websites [36, 37, 38]; which suggest that there are currently tensions between neighbouring countries. Notable countries in the Horn of Africa and the surrounding region include:

- Djibouti
- Eritrea
- Ethiopia
- Kenya
- Somalia
- Sudan

Short profiles on the countries mentioned in this section are shown below in Table 1. Many of these countries have experienced famines and civil wars in recent years. Poverty and disease is likely to necessitate humanitarian aid. Countries such as Sudan are rich in oil that from an economic point of view provides an incentive for the developed world to assist in stabilizing the country. Countries such as Djibouti, have strategic importance in terms of providing access to landlocked countries such as Ethiopia and control of the Red Sea and Gulf of Aden, and associated oil exportation and shipping.

Middle Eastern countries such as Yemen and Iran, and South East Asia in general, were also suggested by SME's and the literature review as being potential areas of instability over the 5-10 year time frame. Countries such as Yemen and Iran may potentially harbour terrorists and it is possible that a similar conflict to the recent Iraq conflict may prevail. There is also a possibility that the small islands that make up Indonesia may break up and form Islamic fundamentalist states.

Areas of instability that are **unlikely** to be areas for UK deployments include:

- Korea. Although there is probability of instability in this region, UK troops are unlikely to intervene as the US controls North Korea and would probably intervene ahead of the UK.
- Central Asia and Caucasus. This region is quite unstable containing diverse ethnic groups distinct from the geo-political boundaries of the areas. It has historical ties to Russia and is geographically position at the edges of old Europe and Asia. As former Soviet States, many countries had been returning to Moscow for economic and security reasons prior to September 11th [27]. It is rich in oil reserves but its recent history as former Soviet Union states would mean that it would be politically difficult for the USA and UK to carry out military operations in the region.

Table 1: Potential Areas of Instability

	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	Sudan	Yemen	Iran	Sierra Leone	Indonesia
Population	702,000 (UN, 2003)	4.1 million (UN, 2003)	70.7 million (UN, 2003)	32 million (UN, 2003)	7 million	33.6 million (UN, 2003)	20 million (UN, 2003)	68.9 million (UN, 2003)	5 million (UN, 2003)	219.9 million (UN, 2003)
Capital	Djibouti	Asmara	Addis Ababa	Nairobi	Mogadishu	Khartoum	Sanaa	Tehran	Freetown	Jakarta
Major languages	French, Arabic, Somali, Afar	Tigrinya, Tigre, Arabic, English	Amharic, Oromo, Tigrinya, Somali	Swahili, English	Somali, Arabic, Italian, English	Arabic; Nubian, others	Arabic	Persian	English, Krio (Creole language derived from English) and a range of African languages	Indonesian, 300 regional languages
Major religions	Islam	Islam, Christianity	Christianity, Islam	Christianity	Islam	Islam, Christianity	Islam	Islam	Islam, indigenous beliefs, Christianity	Islam
Main exports	Re-exports, hides and skins, coffee (re-exported from Ethiopia)	Livestock, hides, sorghum, textiles, salt, light manufactures	Coffee, hides, oilseeds, beeswax, sugarcane	Tea, coffee, horticultural products, petroleum products	Livestock, bananas, hides, fish	Oil, cotton, sesame, livestock and hides, gum arabic	Crude oil, cotton, coffee, fish	Petroleum, carpets, agricultural products	Diamonds, rutile, cocoa, coffee, fish	Oil and gas, plywood, textiles, rubber, palm oil

Source: Country Profiles on <http://news.bbc.co.uk>

2.5 Conflict Drivers

The literature review and SME interviews were in consensus that future conflicts may be driven by human, social and political variables such as population growth and disease. These variables affect the availability of basic human requirements such as fresh water and fuel.

In general, the following conflict drivers have been suggested by the literature review:

- **Natural Disasters**

Changes to the physical environment, such as floods and earthquakes, are likely to influence the lives of people and lead to instability and mass migration of people.

- **Scarcity of Water**

Water scarcity is predicted to increase in the future. “The amount of water used per capita is increasing. In 1989, 9,000 cubic metres per person per year was available and by 2025 the amount of water per capita is expected to fall to 5,100 cubic metres per person as the world's population grows from 6 billion to over 8 billion “ [33]. Although globally there should be enough water available at present it is not distributed equally and not all of it is safe for human consumption. “Currently 3.4 million people die each year as a result of water related diseases “[p2-7, 2].

Recent history has illustrated the increasing importance of water. Evidence suggests that access to drinking water is an important conflict driver: “the water of the Jordan was one of the direct causes of the 1967 Arab-Israeli War.” [pp 138,21].

- **Scarcity of Fuel**

Fossil fuels are the principle source of energy currently and this trend is unlikely to change in the near to medium term future. Oil is easy to extract and transport and therefore will remain the most desirable form of fuel although known oil reserves are only expected to last 40 years at the current rate of consumption [34, 35]. This doesn't mean there will be no oil left in 40 years time as more is being discovered each year, albeit in inaccessible places. However as oil is sought after, it is likely that the price of oil will increase, leading to increased economic instability in certain regions and therefore a higher potential for conflict.

- **Demographic and Economic Pressures**

The global population is increasing [3, 26] and much of this increase is in the developing world [30, 27, 28], including potential areas of conflict identified over the next 5-10 years by the SME interviews, such as the Horn of Africa (CIA World Factbook ref). Increasing population size has two main effects: it increases the economic competition for resources within a region (which can lead to unemployment), and it contributes to an increase in the segment of the population that is fit for military service or turn to terrorist activities and guerrilla warfare. Taken together, these two effects are strong drivers towards conflict.

There is an increase in migration from the developing to the developed world for economic reasons. However in regions with political instability, conflict and natural disasters, migration to adjacent developing world countries is likely to increase. This is happening now in areas of Africa such as the Sudan. The current war in Darfur, North Sudan has forced thousands of Sudanese refugees into neighbour Chad.

Much of the developed world is urbanised [30]. It is expected that 60% of the developing world will be urban by 2030. The CIA World Factbook asserts that “by 2015 more than half of the world's population will be urban”. This means that, there is an increasing chance that future conflicts will occur in urban areas.

- **Prevalence of Disease**

Infectious diseases (such as malaria and AIDS) and chronic diseases (such as cancer) can seriously affect the growth of a population and the growth of a country's economy. In the developed world there a shift in mortality from infectious to chronic diseases, where as in developing countries much of the deaths are from infectious diseases. The largest risks to global security are from infectious diseases particularly ones that can spread quickly. Many diseases that were previously curable (e.g. tuberculosis and dengue fever) have re-emerged in more deadlier forms primarily because the poorer countries cannot afford the expensive medication.

2.6 Nature of Operations

The following section outlines the trends in the types of operation that are likely to be carried out by military personnel over the 5-10 year time frame, based on the literature review and SME interviews.

- **New technology**

In the coming 5, 10 and 15 years the following platforms and capabilities will come into service and will be directly involved in the future conflict scenarios.

Table 2 illustrates the major assets and acquisitions that will have a direct impact on operations in the near future. Each of these new platforms will become a communication node in a global digitised network which will enable the UK armed forces to bring about maximum military force with maximum speed. For example the future infantry soldier will be both a communications node and data gathering resource. This in addition to being a fighting infantry soldier on the ground.

Table 2: Platforms Available in the Next 5, 10 and 15 years

Marine	Land	Air
Type 23 Frigate	Future Infantry Soldier (FIST)	Modernised Nimrod maritime patrol aircraft
Astute class submarine	Warrior APC	Merlin helicopter
Type 45 Destroyer	Future Rapid Effects System (FRES) vehicles	Harrier GR7
Invincible Class carrier	Challenger 2 Main Battle Tank (MBT)	Sea Harrier
CVF	AS90 Self Propelled Gun (SPG)	Apache attack helicopter
Sandown minehunter vessels	MLRS	Typhoon
Hunt minehunter vessels	MRAV	Tornado GR4
Amphibious landing ships	COBRA	ASTOR
Helicopter carriers	TRACER	PHOENIX
RO-RO container ships	Rapier Surface to Air Missile	C-130J
Future Surface Combatant (Type 23 replacements)	HVM Surface to Air Missile	C-17
		A400M
		Joint Combat Aircraft
		UCAVs
		Stand-off missiles
		Tanker aircraft
		Chinook

While NEC might provide a coordination capability, the surface and air transport vehicles will provide the capability to move troops and equipment around the world in large enough numbers to produce an immediate effect. The acquisition of the C-130J and the A400M ensures that air transport will be available and capable well into the next 15 years. The new carrier, CVF, RO-RO container ships and amphibious landing ships will provide surface transport and air superiority capabilities. Land-based aircraft such as Typhoon and Tornado will also contribute to air superiority.

The potential complexity caused by working within a large network emphasises the requirement for effective management of information. Acquisitions such as ASTOR, PHOENIX, and COBRA will ensure that the ISTAR capabilities of modern forces are maintained, and that gathered data are presented as information in a timely fashion. Since the cognitive capabilities of the human component of each system will not change, it is essential that the operator be supported in his

task as far as possible. Essentially this means that the design of not only equipment, but of whole systems and operational procedures must be taken into account when considering the utility of new acquisitions. While this is important now, as interconnectivity grows, and the expectation of near real-time information becomes a reality, the human factor will be even more important in future systems.

- **Increasing asymmetry**

There are many definitions of asymmetric warfare. Essentially asymmetric warfare is conflict where the respective sides have uneven resources and strengths.

Intelligence gathering and surveillance will become an increasing trend in the future. Future conflicts are less likely to be between nations and more likely to be between secular groups. The individuals in the groups will be driven by strongly held internal beliefs. Given that the new enemy is so different from the past (i.e. in the Cold War) it is interesting that the current fight against such individuals uses the Manoeuvrist Approach which one might usually associate with symmetric warfare. The aim of the Manoeuvrist approach is to win by “crushing the enemy's will and destroying his beliefs”. In the past, this may have been easier to “break the enemy’s resolve”, when the main threat was from the Soviet Union and Eastern Europe, in which a considerable percentage of the army were conscripted¹ and therefore less motivated to win, in contrast to the smaller enemies of the present and future who are more internally driven.

In asymmetric conflict the enemy will use untraditional war strategies to gain an advantage. It is interesting that the smaller the enemy group the less likely they are to wear uniforms. The UK and her allies will be forced to search for enemy combatants among the civilian population. This means that information must be accurate, timely and available when needed to ensure that the right targets are identified.

Increasingly anti terrorism operations will involve the sharing of information from home office agencies such as the police, coast guard, port and airport authorities and with international consortiums such as NATO and the UN. This involves investigating how to build trust between these different organisations and the development of structures and information systems to support passing of information.

- **Emphasis on conflict prevention and peace support operations**

¹ Bellamy asserts that the conscript armies of Europe have decreased since the second world war.

The aim of conflict prevention is to maintain international stability by building and maintaining trust. In some ways, the objective of “winning a war without fighting it” does not vary hugely from theories of war dating back to 400BC².

Preventing conflict in a practical sense is a diplomatic activity. The type of activity varies and involves several government departments. Defence diplomacy activities include visiting other countries, sharing education and training, providing advice to overseas Defence Ministries, participating on joint exercises and monitoring arms control agreements.

As a hostile situation develops the armed forces take on an enforcing or policing role. This involves setting up checkpoints (on land) or patrolling strategic stretches of sea to check for illegal goods traffic or to enforce economics embargos. The aim of these actions is to coerce the sides to engage in negotiations towards a peace agreement.

Confrontation may still develop even with an agreement in place and armed forces may be required to maintain stability. In most peace support operations (PSO) the military will be working within a network of other organisations including the host countries government, non-governmental organisations such as UN and commercial organisations. The main purpose in these situations is to support and restore basic facilities to the local population and create the circumstances to allow other organisations to assist in returning the population to normality.

Following a conflict the military must try to shift the perceptions of the indigenous people, the move from wearing helmet to berets after the “fall of Saddam” was widely shown in April of last year. “A modern soldier needs to be a diplomat” (interview with Col Olley), they must understand how to develop trust with the local population.

There will be greater co-ordination between the Maritime, Land, Air, Special forces and Logistics Components [15]. Command strategies will need to consider each of the strengths of each the armed services within the network and plan to these strengths.

Increasingly the PSOs operate in an international network. This in itself introduces challenges not only to do with language and inequalities in technological capability but with underlying command strategies and political background. The different national armed forces may have a different way of interpreting the command intent and may come from a country with a different political agenda to that of the UK or US.

Increased joint multi national, defence and non-governmental organisation will have an impact on the people working within the network.

²Sun Tze wrote in 400-320 BC in a book called “The Art of War” that the goal of a war strategy is “to subdue the enemy without engaging it, to take his cities without laying siege to them and to overthrow his state without bloodying swords”

- **Changing size and nature of battlespace**

The future battlespace will be influenced by technology and human geography. Advancements in long-range missile technology mean that targets can be reached from outside conventional national and physical boundaries.

Recent wars have been smaller conflicts as opposed to the world wars of the early twentieth century. This trend has continued and many of the smaller interventions have involved asymmetric conflicts with opposing forces hiding themselves and their weapons within civilian populations. For a number of reasons (discussed in section x), future battlespace is likely to occur within an urban context.

- **Greater influence of legal and media perception of conflict**

Since September 11th 2001, the idea of a legal war has become mainstream discussion as opposed to military theory [44]. In general the laws of war, which comprises the four Geneva Conventions of 1949 amongst others are set up to protect civilians and other non-combatants. Recent news stories involving the UK troops treatment of civilian Iraqis [45] and the US troops treatment of prisoners of war [46], have highlighted how this subject can form a message in the media that various parties can use to back their own views [48].

War is no longer hidden from world scrutiny; the media pervades the conflict space and reports back the actual brutalities of war. This trend likely to continue, “the media will be like weather in the future” (Interview with Prof. Bellamy), it may effect the outcomes or the manner in which a war is fought but it will not be a participant or part of the network of agencies working within the conflict.

It is also important to note that over and above the legal constraints of war, modern society through the media is becoming increasingly intolerant of war casualties.

- **Increased number of humanitarian operations**

The armed forces are often called upon to carry out humanitarian work. This consists of providing assistance to help carry out humanitarian operations but more often entails providing security support to non-governmental organisations (NGOs) missions. NGOs are essentially charitable organisations such as Oxfam, Christian Aid, Medicin Sans Frontiers or the International Red Cross. In situations where the armed forces are required, the NGOs will physically tend to the people but the armed forces will assist with keeping order. In a minority of cases the armed services may also assist with some non security tasks such as building temporary shelter, latrines or tending to the sick and injured.

The literature review and SME interviews suggested that these types of operations are likely to increase. The increasing joint work with NGOs effectively means that many of these organisations become part of the network. In terms of communication

technologies, NGOs are likely to have less sophisticated technology therefore current and future technologies should be backwards compatible.

On an ideology level, the armed forces and NGOs have different motivations for carrying out humanitarian work. The armed forces exist to use any force necessary to achieve the government's foreign office policy whereas NGOs are often charities that exist to campaign and assist practically with delivering human rights to countries in need of help. As a rule NGOs do not use physical force, although they may assist following conflict and many rely on local people within their networks to deliver local help. Organisations like the International Red Cross have started to run courses for the armed services to help them to learn the new rules of engagement [51].

- **More emphasis on 'effects based operations'**

Effects-Based Operations is a modern term that describes an approach to the use of force to serve political or strategic ends. It supports the Manoeuvrist Approach. The core philosophy is to disable the enemy using indirect (attacking infrastructure) strategies as a preference to direct methods (firing at the enemy) in order to achieve the desired effect.

- **Increasing digitisation**

Digitisation will enable the current channels of communication between members of the battlespace network to be rapid and responsive. This new networked warfare is often called Networked Enabled Capability (NEC) or Network centric Warfare (NCW).

Networked Enabled Capability is defined [50] as "Linking sensors, decision makers and weapon systems so that information can be translated into synchronised and overwhelming military effect at optimum tempo".

Essentially digitisation of the communications network should enable parties in the network to share an awareness of themselves and the other parties in the network, and to use this knowledge to work in a co-ordinated but flexible manner. A tighter network has the potential to be more predictable in a planning sense (in that the mission is achieved to the plan) but also more adaptable when the plan changes.

- **More responsive command and control structures**

The changing responsibilities and practices of the military are likely to have a profound influence on the command and control structure used in future operations. According to some sources "we may be looking at a flattening of the control and command structure" (Interview with Prof Bellamy). Digitisation and NEC provide the potential capabilities to shorten the chain of command from the Prime Minister to the battlespace. NEC also provides a potential environment in which the theory of "mission command" could be possible and successful. "Mission Command" is the idea that the "mission intent" or mission goal is communicated down the hierarchy rather than the method of achieving the goal. This allows the subordinate

commanders to use their own initiative and problem solving skills in order to meet the strategic and operational goals.

However, for people who have been used to the old method of command, the idea of having responsibility for the actions of subordinate without giving them precise instructions requires the two parties to respect and trust each other.

3 Potential Future Deployment Scenarios

The following scenarios were developed from the interviews. The tables sum up potential conflict scenarios. These are a combination of the global context, conflict driver and nature of operations described in the previous section.

3.1 5 years from now (2009)

Table 3: Potential Scenarios in 2009

Global Context	Conflict Driver	Nature of Operation
Horn of Africa/ Sudan	Recent History: Civil wars and conflict with neighbouring countries; deforestation; overgrazing; soil erosion; desertification; water shortages in some areas from water-intensive farming and poor management; loss of infrastructure from civil warfare; inadequate supplies of potable water; use of contaminated water contributes to human health problems; some regions have limited arable land; endangered species; famine;	Peace Support Operation (PSO); Humanitarian, Counter terrorism All types at once i.e. Three block operations ³
Balkans	Recent History: Civil war; break up of the former Yugoslavia. This has caused air pollution (from metallurgical plants) and resulting acid rain is damaging the forests; coastal pollution from industrial and domestic waste; landmine removal and reconstruction of infrastructure consequent to 1992-95 civil strife; sites for disposing of urban waste are limited; pollution of coastal waters from sewage outlets, especially in tourist-related areas such as Kotor; water pollution from industrial wastes dumped into the Sava	Urban Operations Peace Sustainment

³ The "three block war" is a phrase coined by General Charles Krulak of the US Marine Corps to describe carrying out diverse operations within the same city blocks.

He used the phrase to describe a new type of increasingly, complex, urban type of war. In one block a high intensity war would be waged against trained, well-equipped enemy. In a second block, the conflict would be against a less well equipped guerrilla-style forces. In a third block troops would be carrying out peacekeeping and humanitarian aid. He described it as "the three-block war".

	which flows into the Danube	
West Africa	Recurrent drought in north severely affects agricultural activities; deforestation; overgrazing; soil erosion; poaching and habitat destruction threatens wildlife populations; water pollution; inadequate supplies of potable water; deforestation; desertification; deforestation attributable to slash-and-burn agriculture and the use of wood for fuel; air pollution increasing in urban areas	Humanitarian,
Sierra Leone	Rapid population growth pressuring the environment; over harvesting of timber, expansion of cattle grazing, and slash-and-burn agriculture have resulted in deforestation and soil exhaustion; civil war depleting natural resources; over fishing	Humanitarian,
Iraq	Government water control projects have drained most of the inhabited marsh areas east of An Nasiriyah by drying up or diverting the feeder streams and rivers; a once sizable population of Marsh Arabs, who inhabited these areas for thousands of years, has been displaced; furthermore, the destruction of the natural habitat poses serious threats to the area's wildlife populations; inadequate supplies of potable water; development of the Tigris and Euphrates rivers system contingent upon agreements with upstream riparian Turkey; air and water pollution; soil degradation (salination) and erosion; desertification	Counter terrorism Peace Support Operation

3.2 10 years from now (2014)

Table 4: Potential Scenarios in 2014

Global Context	Conflict drivers	Type of Operation
Horn of Africa/ Sudan	Recent History: Civil wars and conflict with neighbouring countries; deforestation; overgrazing; soil erosion; desertification;	Peace Support Operation (PSO) Humanitarian,

	<p>water shortages in some areas from water-intensive farming and poor management; loss of infrastructure from civil warfare; inadequate supplies of potable water; use of contaminated water contributes to human health problems; some regions have limited arable land; endangered species; famine;</p>	<p>Counter terrorism Three block operations</p>
<p>Iraq</p>	<p>Government water control projects have drained most of the inhabited marsh areas east of An Nasiriyah by drying up or diverting the feeder streams and rivers; a once sizable population of Marsh Arabs, who inhabited these areas for thousands of years, has been displaced; furthermore, the destruction of the natural habitat poses serious threats to the area's wildlife populations; inadequate supplies of potable water; development of the Tigris and Euphrates rivers system contingent upon agreements with upstream riparian Turkey; air and water pollution; soil degradation (salination) and erosion; desertification</p>	<p>Peace Sustainment</p>
<p>South East Asia – Indonesia if it breaks into 20 countries and some become Islamic states</p>	<p>Deforestation; water pollution from industrial wastes, sewage; air pollution in urban areas; smoke and haze from forest fires</p>	<p>Counter terrorism</p>
<p>West and Central Africa (diamonds)</p>	<p>Recurrent drought in north severely affects agricultural activities; deforestation; overgrazing; soil erosion; poaching and habitat destruction threatens wildlife populations; water pollution; inadequate supplies of potable water; deforestation; desertification; deforestation attributable to slash-and-burn agriculture and the use of wood for fuel; air pollution increasing in urban areas</p>	

3.3 15 years from now (2019)

Literature review and interviews were less successful for defining potential wars at this level of granularity for this timescale.

4 Future Research

4.1 Objectives

The overall objective of this work package is to identify what can be done to reduce the training gap between current capability and future educational attainment. This report deals with the high-level tasks, missions and goals that future service people are likely to encounter. Future research is needed to drill down to a lower level of detail in order to pull out the specific education and training needs.

Future work should build on the scenarios sketched out in this report. For each scenario further detail on the future users and the specific tasks that are required for the given scenario should be established. A matrix of specific tasks required to carry out a certain mission such as peace keeping in Iraq can then be constructed against specific job roles in the army, navy and air force. This will result in a detailed set of future operational requirements. The skills and educational attainment of current personnel can also be compared against these operational requirements. The training gap is the skills gap between current capability and the required future operational requirements.

Education and training objectives should then be developed based on the identified training gaps. The training methods, media and materials should be selected according to the nature of the skills that must be taught.

One of the principle HF concerns associated with future deployment scenarios is that human information processing capabilities may not be sufficient to cope with the nature or amount of digital information within the battlespace network. This report has suggested that a useful model of human information processing would include functions for the collection, assimilation, problem solving, and communication of information. Within this framework, future work should focus on the impact of the detailed future scenarios on human information processing.

4.2 Summary of Future Work

The following framework is suggested for future work:

- Conduct a hierarchical task analysis, including mission, goal, and task-level activities within the future scenarios identified in this report
- Identify the personnel roles within the scenarios, considering the tri-service aspects of operations, and the functions and roles provided in each service
- Develop the operational requirements
- Identify the skills and education capabilities of current users and compare against the operational requirements

- Establish the training gaps and select the most appropriate training methods and media to impart the knowledge required to meet the operational requirements

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