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A Framework For Strategic Military Capabilities In Defense Transformation

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Abstract

For transformation to be an effective process, the defense industry must have a clear and common understanding of military capability. However, capability is an abstract concept. In order to make this concept more tangible effects-based operations, force structures and the lines of capability development have been integrated. A conceptual framework is proposed for the mapping and visual representation of these strategic capability partitions. The framework is formed of four concentric layers: i) building blocks, ii) functional packages, iii) effects and iv) influencers. The building blocks of capability consist of lines of common facilities interwoven with the spectrum of strategic platforms. Bonded onto the capability building blocks are the functional packages which represent the warfighting force structures together with the operational environment domains. The next layer integrates the effects-based approach while the fourth and final layer links these three views of military capability with the set of influencers, namely: policy, commitments, threats, scenarios and concept of operations. The mapping of capabilities onto the framework then allows the stakeholders to develop their transformation roadmaps and synchronize the associated capability development plans. To illustrate the application of the framework, a visual representation has been populated with case data for the United Kingdom.

1. Introduction

When Lord Robertson started his term of office as NATO's 10th Secretary General in 1999, he clearly articulated three key priorities: "capabilities, capabilities, capabilities" (Robertson 2000). A military force is "only as effective today as current capabilities allow. And, in future, it will only be as effective as investments in new capabilities made today will allow" (Ankersen 2005). Thus the generation, deployment, sustainment and enhancement of military capability represents a common thread for the world's defense community. Yet, the term 'capability' has many meanings and various different levels of abstraction both within and between the three broad stakeholder groups of warfighter, government and industry. With the increasing focus on defense transformation, there now needs to be a coherent and mutually understandable representation of capability. The Centre for Technology Management at the University of Cambridge has been actively researching in this area and has developed a framework that encapsulates the concept of defense capability. The application of the framework is intended to allow the stakeholders to explore what capabilities are needed in the future and to develop a visual representation of those future capabilities, such that a shared understanding can be reached. This paper presents the architecture of the 'capability framework' and then shows how this can be applied in

practice. A visual representation of the United Kingdom's future military capability is built up as an illustrative case study.

2. Framework architecture

The framework consists of four concentric layers as presented in Figure 1. At the heart of the architecture, upon which the framework is built, is Layer 1 which contains the basic 'building blocks' of capability. There are two elements to this layer, namely 'platforms' and the associated 'facilities' that surround a platform. Consider first the platforms element, in terms of defense transformation the question that needs to be explored by the defense community is what are the future strategic platforms that will provide a step change in capability? Although there are numerous discussions on the issue of migrating from platform-centric or platform oriented programmes to a more functional and effects perspective of capability, platforms are still a critical building block and will remain so in the future. It can be argued that platforms are the bedrock of capability. It must be acknowledged that the problem of 'platform myopia' really stems from the lack of a holistic view and not putting platforms into context when considering what constitutes 'military capability'. With this in mind, in order for a platform to be utilized as a military capability the second elemental building block is the facilities that surround a platform. For example, a number of common lines can be interwoven with a platform such as the associated training, doctrine, infrastructure, logistics and maintenance. This is exemplified by Ankersen (2005), in rather crude terms, by stating the obvious that "without trained personnel, the best equipment is of no use." These 'common facilities' exist in a hierarchical manner ranging from the platform level up to being generally applicable across a coalition. The levels in the hierarchy are:

1. Common to a platform, e.g. JSF.
2. Common to a service branch, e.g. USAF.
3. Common across the services, e.g. US Forces.
4. Common across a coalition, e.g. NATO.

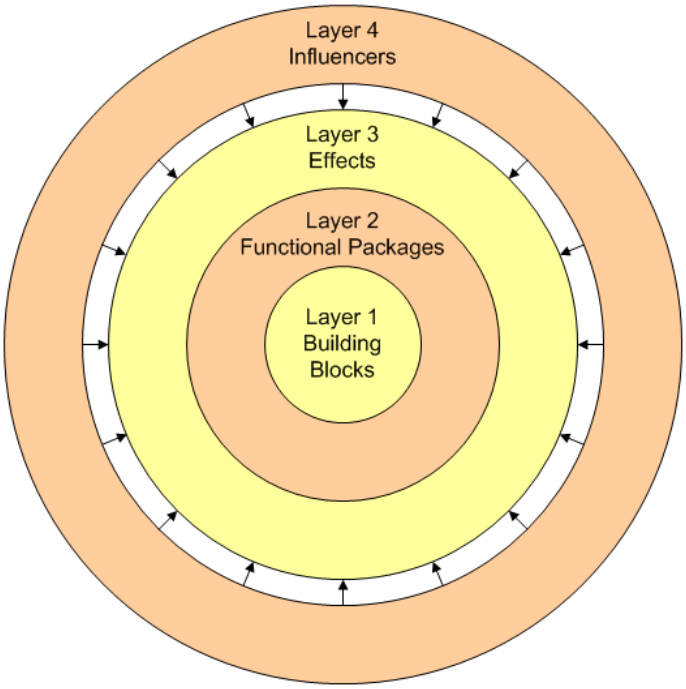

Figure 1: Architecture of the framework

Capability must also be considered from the perspective of combat functions or 'functional packages' of military capability. The functional packages layer encapsulates the warfighting force structures together with the operational environment domains (land, maritime and air). This is represented in Layer 2, depicted in Figure 1, which is bonded around the building blocks of platforms and common facilities. It must however be noted that future functional packages are to be determined independently of any particular platform or group of platforms. Examples of functional packages would be: deep strike, airlift, combat support, command and control. In terms of a real-life example, there is the US Forces' contribution of precision strike, surveillance, refueling, lift, high-end command and control during NATO's operation in Kosovo (Appathurai 2002). It is necessary for each branch of the military to determine functional package requirements for the future and plot these onto the framework. For defense transformation, it is critical that the relationships between the functional packages are considered in order to prevent what Atkinson & Moffat (2005) call 'single-service stovepiping' and thus encourage joint working between the service branches. The United Kingdom's Ministry of Defence even use the term 'jointery' to define the 'joined up thinking' between the army, navy and air force.

Layer 3 then integrates the effects-based approach. This is essentially a third view with capability being represented by an 'effect'. In terms of defense transformation, the question that needs to be explored by the defense community is what are the future effects that must be realized? For example, what are the effects that must be employed to address the threat of asymmetric warfare? Effects can be defined from three perspectives, namely: strategic, tactical and operational. The application of a combat function delivers a set of specific effects as does the use of a particular platform. Thus it is also essential to trace the capabilities between the three layers of the framework. For example, if a particular effect is to be applied, which platforms could be utilized? The final layer in the architecture is the 'influencers' layer (Layer 4 in Figure 1). Whereas Layers 1 to 3 encapsulate capability by representing the different views, Layer 4 is not a capability but it categorizes the factors that have a direct influence on capability. These influencers include government policy, defense budgets, commitments, threats, scenarios and concept of operations. To illustrate how the framework can be populated in order to produce a single visual representation of military capability, the United Kingdom's Ministry of Defence (MoD) will be used as an example. The subsequent sections of the paper will build up this picture step-by-step from the building blocks of Layer 1 through to the influencers of Layer 4.

3. Building blocks layer

3.1. Platforms

In the 'Delivering security in a changing world' white paper, the MoD states that "future military capability is dependent upon the equipment our forces operate and the technology that underpins this" (MoD 2003a). From this premise, the starting point in building a visual representation of the UK's military capability is to ask the question: what are the future strategic platforms that will provide a step change in capability? A select number of these platforms are shown in Figure 2. It must be remarked that there is a clear trend that current platforms will be replaced by fewer platforms, however these future platforms will be more capable and flexible in their capabilities (Burridge 2004). Firstly consider the air platforms, defined by the British Air Power Doctrine as "any aircraft, helicopter or unmanned air vehicle" (MoD 1999). A recent example of a multi-role air platform entering service is the WAH 64 Apache. Not only is the Apache an extremely capable attack helicopter it will be increasingly relied upon to provide various levels of battlespace reconnaissance (MoD 2003a). With

respect to defense transformation, the introduction of the Apache represented a "step change in capability compared to current in-service helicopters" (MoD 2003a). When the decision to acquire the Apache as a future strategic air platform was being made General Sir Charles Guthrie, the Chief of the General Staff at the time, stated:

> "*I have no doubt whatsoever that the Attack Helicopter will represent the biggest single enhancement to the Army's capability for many years. It will change the way we go to battle*" (NAO 2002).

In terms of fast jets, the MoD has selected the Typhoon and JSF multi-role fighters. The Typhoon will undertake the roles of air superiority, air defense and ground attack (RAF 2003). Air Chief Marshal Sir Brian Burridge, Commander-in-Chief of Strike Command, states that the "Typhoon will become the foundation of our ability to gain and maintain control of the air" (Burridge 2004). Whereas the JSF will undertake the roles of deep strike, close air support, reconnaissance, air defense and perhaps an additional electronic warfare capability (Jermy 2004). Both of these fast jets are expected to have a service life of over 30 years (MoD 2005a). There is also the replacement of the Nimrod MR2s by, fewer, Nimrod MRA4s. This replacement should not be thought of as a modernization programme just because the main roles of the MRA4 will be the same as the MR2, namely anti-submarine warfare (ASW), anti-surface-unit warfare (ASUW), search and rescue (SAR) (MoD 2005a). Instead, the MRA4 is a transformation programme since there will be a step change in capability. The Nimrod MRA4 platform will have an ISTAR functionality (Burridge 2004). Thus, new roles will emerge such as "law-enforcement tasks including anti-smuggling and anti-gun-running operations, fisheries protection and counter-terrorism duties" (RAF 2003). There are even discussions that the MRA4 could have a Land ISTAR functionality. Additionally there is the Future Strategic Tanker Aircraft (FSTA), which replaces the VC10s and Tristars (DefCom 2005a), and the Watchkeeper UAV for Land ISTAR.

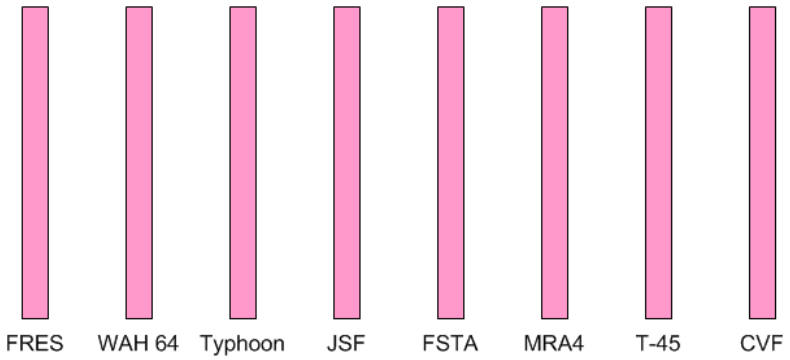

Figure 2: Platforms

Turning to maritime platforms, two examples of future strategic platforms for the UK are the T-45 and CVF. "In terms of naval capability, the Type 45 Destroyer represents a huge improvement in capability" (Emery 2005). "The Type 45 Destroyer will provide the Royal Navy's primary 'Anti Air Warfare' capability for over thirty years" (MoD 2005a). One major step change in capability of the T-45 and its Principal Anti-Air Missile System (PAAMS) over the Sea Harrier is that the "Sea Harrier's air defense capabilities are principally effective against other aircraft" (DefCom 2005a) whereas the MoD sees the future threat being from sea-skimming missiles rather than hostile aircraft. Additionally, the two new aircraft carriers (CVFs) equipped with JSFs will transform the Royal Navy's "capability to project power from the sea" (DefCom 2005a).

Finally, the most strategically important future land programme is the Future Rapid Effects System (FRES). The FRES is essentially a family of vehicles (DefCom 2005a) or more concisely "a family of network-enabled medium weight armored vehicles covering a wide range of combat, combat support and combat service support roles" (MoD 2005a). The aim of the Future Rapid Effects System is to offer "supremacy in battlespace awareness, improved command and control, precision engagement, survivability and mobility" (Anon 2005). This future platform intends to achieve a family of vehicles that balances the mobility of a 'light' force and the combat performance of a 'heavy' force (Anon 2005). To highlight the importance of the FRES platform to the UK consider the following statement by the House of Commons Defence Committee on future capabilities:

> "*The Army does not currently have a medium weight capability and will not have until the proposed Future Rapid Effect System (FRES) is introduced*" (DefCom 2005a).

It is useful to consider the grouping of platforms to specific areas of capability. For example, the following air platforms have been grouped together by the MoD to obtain the capability area of 'Deep Strike' (NAO 2003) and a 'Deep Strike Integrated Project Team' (IPT) is formed around these platforms:

- Conventionally Armed Stand-Off Missile
- Future Offensive Aircraft System
- Future Strategic Tanker Aircraft
- Harrier
- Joint Combat Aircraft (i.e. the JSF)
- Maritime Airborne Surveillance and Control
- Precision Guided Bomb
- Tomahawk Land Attack Missile
- Tornado

It should be noted that this deep strike capability (Layer 1) is different to the deep strike capability, in the form of a functional package (Layer 2), previously mentioned in Section 2. The differentiation being that the Layer 2 deep strike capability can be employed to generate a military effect (Layer 3); whereas the Layer 1 deep strike is the capability provided by a number of platforms to a Layer 2 functional package. This natural linkage from the platforms in Layer 1 through the functional packages in Layer 2 to the effects in Layer 3 is one of the key attributes of using the capability framework presented in this paper.

Table 1: Top-level equipment capabilities (MoD 2003b)

C4	Readiness
Strategic Mobility	Intra-theatre Mobility
Intelligence, Surveillance & Reconnaissance	Long Range Strike
Control & Denial of the Above Water Battlespace	Control & Denial of the Under Water Battlespace
Control & Denial of Theatre Airspace	Control & Denial of the Land Battlespace
Military Support to Civil Organisations	NBC Defence
Counter-Terrorism	Logistic Support

The MoD has developed a capability taxonomy that can be adopted within the framework. Their categorization consists of 14 key high-level equipment capability groupings as presented in Table 1. Equipment capability has been defined by the MoD as "the capacity afforded by an equipment to a unit or force element to perform a task in a given environment or operational context" (MoD 2003b).

Further, these high-level equipment capabilities are broken down into their constituent parts. For example, Table 2 shows the components of the 'Control and Denial of Theatre Airspace' capability. This allows the mapping of how and where each platform contributes to the necessary capability components of the high-level groupings embodied in the taxonomy.

Table 2: 'Control and denial of theatre airspace' capability components (MoD 2003b)

Control & Denial of Theatre Airspace	Active protection from air attack	Responsive and flexible theatre-wide protection of land and sea surface from air attack	Active protection of land and sea targets against airborne delivery means
			Active protection of land and sea targets against ballistic delivery means
		Protection from air attack for key assets or areas of more limited extent	Active protection of land and sea targets against airborne delivery means
			Active protection of land and sea targets against ballistic delivery means
			Active protection of airborne targets against airborne attack
			Protection of space-based assets.
		Extra-theatre protection from air attack	Protection of surface-based targets
			Protection against ballistic delivery means
			Protection of airborne targets

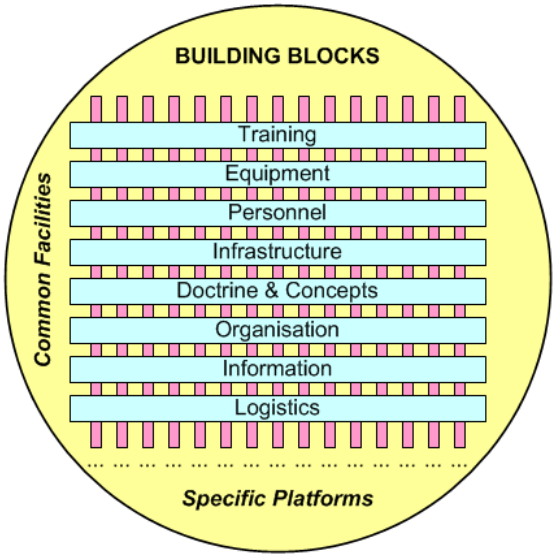

Figure 3: Building blocks

3.2. Facilities

During his term of office as the Director of Strategy of the MoD's Defence Logistics Organisation (DLO), Commodore Bob Mark acknowledged that traditionally the MoD "has encouraged industry to focus on selling a product, not on sustaining a capability through its life" (Mark 2004). The MoD is undergoing a step change from procuring a product/platform to a more end-to-end through-life

approach. The through-life approach is described as a "whole-system outlook taking an integrated approach to delivering all of the components of military capability not just the equipment" (NAO 2003). The MoD goes as far as to class this as a "new paradigm centered on support, sustainability and the incremental enhancement of existing capabilities from technology insertions" (MoD 2005a). The rationale is that procuring a platform "does not in itself generate a useable military capability" (MoD 2005b) as there is also the requirement to provide and integrate all of the support and service elements. This through-life capability management philosophy for a platform is fully captured in the building blocks layer of the framework by intertwining the platforms with the common lines of facilities that support and service those platforms through their life as depicted in Figure 3. In the UK, these common facilities are termed the 'Lines of Development' (LoD) and are defined as "the elements that must be brought together to deliver military capability to operational users" (NAO 2005). This definition maps onto the framework whereby the platforms and associated facilities embody the building blocks for the functional packages or force structures for each of the service branches of the military. For example, the Royal Navy's strategic plan states that the lines of development are "the levers across the department that contribute directly to the generation of military capability" (RN 2003). The lines of development are classified by the acronym TEPID-OIL, which stands for:

- Training
- Equipment
- Personnel
- Infrastructure
- Doctrine and concepts
- Organization
- Information
- Logistics

The descriptions underlying each of the lines of development are given in Table 3. The MoD has defined four levels of capability integration and this is Level 1 which is "concerned with integrating the LoD within an equipment project so that a capability is delivered and not just a new piece of equipment" (MoD 2005b). The other three capability integration levels are also captured in the framework and will be described at the appropriate points further in this paper.

Table 3: Defense lines of development

Training	The provision of the means to practice, develop and validate, within constraints, the practical application of a common military doctrine to deliver a military capability.
Equipment	The provision of military systems and weapons, expendable and non-expendable (including updates to legacy systems), needed to outfit/equip an individual, group or organization.
Personnel	The timely provision of sufficient, capable and motivated personnel to deliver defense outputs, both now and in the future.
Infrastructure	The acquisition, development, management and disposal of all fixed, permanent buildings and structures, land, utilities and facility management services in support of defense capabilities. It includes estate development and structures that support military and civilian personnel.
Doctrine and Concepts	Doctrine is an expression of the principles by which military forces guide their actions and is a codification of how activity is conducted today. It is authoritative, but requires judgment in application. A concept is an expression of the capabilities that are likely to be used to accomplish an activity in the future
Organization	Relates to the operational and non-operational organizational relationships of people. It typically includes military force structures, MoD civilian organizational structures and defense contractors providing support.

Information	The provision of a coherent development of data, information and knowledge requirements for capabilities and all processes designed to gather and handle data, information and knowledge. Data is defined as raw facts, without inherent meaning, used by humans and systems. Information is defined as data placed in context. Knowledge is information applied to a particular situation.
Logistics	The science of planning and carrying out the operational movement and maintenance of forces. In its most comprehensive sense, it relates to the aspects of military operations which deal with: the design and development, acquisition, storage, transport, distribution, maintenance, evacuation and disposition of materiel; the transport of personnel; the acquisition, construction, maintenance, operation, and disposition of facilities; the acquisition or furnishing of services, medical and health service support.

Source: (MoD 2005c)

Of course each of the lines of development can be broken down into their constituents. For example, the 'Training' line will contain the elements of: Train the Trainers, Train the Maintainers, Training Needs Analysis (TNAs), Individual Conversion Training (In-Theatre), Individual Conversion Training (Pre-Deployment) and Collective Training (MoD 2005b). A special mention must be made about the 'Equipment' line of development. This line encapsulates the concept that a platform is a 'shell' for the systems, equipment, components and enabling technologies. For example, the main armament on the Type 45 Destroyer will be the PAAMS suite which will comprise of the "8-cell Sylver Vertical Launch System for Aster missiles (both shorter-range Aster 15 and longer-range Aster 30), the Sampson multi-function active array radar, the S1850M long range radar and the Combat Management System" (Emery 2005). This system is core to the T-45's 'Anti Air Warfare' capability in order to defend it and other vessels from both sea-skimming missiles and enemy aircraft. The point to make is that a platform's capability is inherently delivered through the equipment line and it is this line of development where upgrades and updates are inserted. In a taxonomy developed by the Centre for Technology Management at the University of Cambridge, technology insertion is defined as the utilization of a new or improved technology in an existing product (platform). This is to satisfy a needed capability, counter an obsolescence threat or address an affordability issue. The UK's 'Defence Industrial Strategy' clearly acknowledges that the "future business for the defense industry in many sectors will be in supporting and upgrading platforms, rapidly inserting new technology to meet emerging threats, fulfill new requirements and respond to innovative opportunities" (MoD 2005a). Technology insertion will be a vital process in the MoD achieving their vision of 'Network Enabled Capability' (NEC) which involves "both bringing together previously unconnected capabilities and ensuring that new systems and platforms are network-ready" (MoD 2003a). A final comment to make about the equipment line of development is that this is where technologies, from the research and development space, enter into the product space. In terms of defense transformation, it is critical to identify the enabling technologies that will provide the future step changes in capability. For example, the US's Defense Science Board (DSB) and the UK's Defence Scientific Advisory Council (DSAC) joint working party on 'Critical Technologies' have identified five major transformational technology areas that they have deemed critical (DSB/DSAC 2006). These technology areas are:

- Advanced command environments
- Persistent surveillance
- Power sources/Management for small, distributed networked sensors
- High performance computing
- Defense critical electronic components

Although lines of development are a UK construct, any nation's defense facilities can be mapped into the framework. There are equivalents to the UK's TEPID-OIL, e.g. FIC, PRICIE and DOTMLP. These are reported in Table 4. FIC is the 'Fundamental Inputs to Capability' and is an Australian construct. PRICIE is the acronym representing the Canadian construct of capability inputs and DOTMLP is the US's construct.

Table 4: National constructs for the common facilities

AUS	CAN	UK	USA
• Organization • Personnel • Collective training • Major systems • Supplies • Facilities • Support • Command & management	• Personnel • R&D / Ops research • Infrastructure & organization • Concepts, doctrine & collective training • IT Infrastructure • Equipment, supplies & services	• Training • Equipment • Personnel • Infrastructure • Doctrine & concepts • Organization • Information • Logistics	• Doctrine • Organization • Training & education • Materiel • Leadership • People

4. Functional packages layer

Bonded around the building blocks is the functional packages layer. This encapsulates the future elements of the warfighting force structures in defense transformation. These functional packages are linked to their respective operational environments, i.e. air, maritime and land. Figure 4 illustrates the population of the framework with the future functional packages for the British Forces.

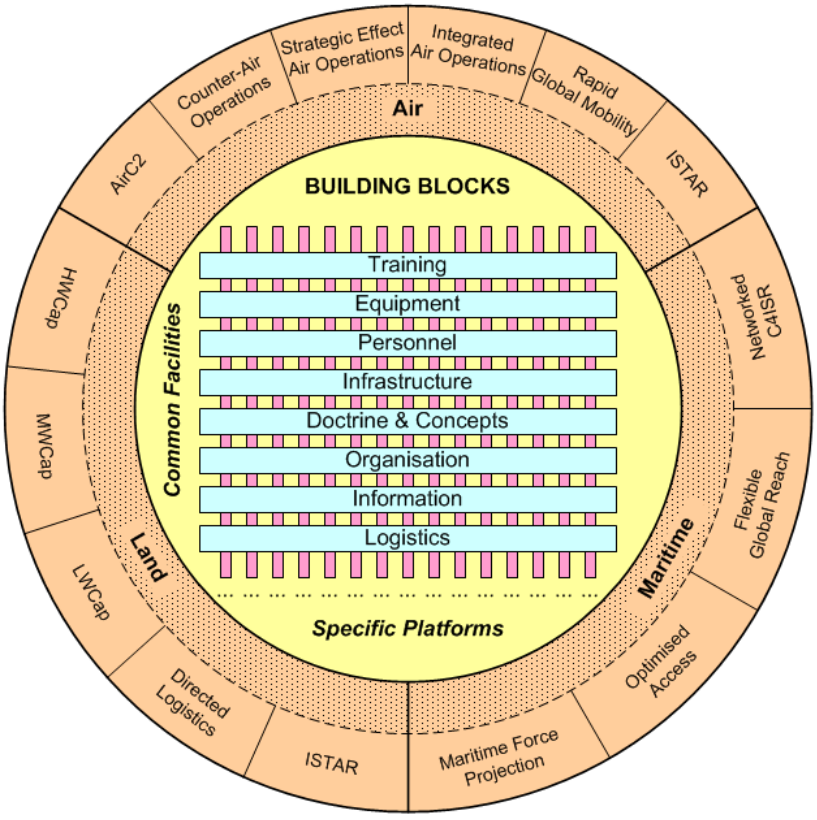

Figure 4: Building blocks and functional packages

Consider first the functional packages for the air environment, the 'Future Air and Space Operational Concept' (FASOC) outlines the UK's future air and space power capability in a 20 year timeframe (RAF 2005). The FASOC vision of agile air power identifies six 'Core Air and Space Power Roles' (CASPR). These are:

- AirC2
- Counter-Air Operations
- Air Operations for Strategic Effect
- Integrated Air Operations
- Rapid Global Mobility
- ISTAR

Each of the functional packages of capability is described in Table 5. The FASOC (RAF 2005) also defines a number of key attributes, for application across these packages of operational functionality, under the three headings of:

- Combat Power – payload, potency, precision and discrimination.
- Survivability – probability of detection, self-protection and stand-off.
- Agility – flexibility, adaptability and also interoperability.

Table 5: Future air functional packages

AirC2	Operations which ensure the efficient planning and execution of air power operations. Future AirC2 should, as far as possible and affordable, be interoperable with potential coalition air C2 systems and structures, in particular those of the US.
Counter-Air Operations	Operations conducted to achieve a required degree of control of the air.
Air Operations for Strategic Effect	Operations directly aimed at reducing or eliminating an enemy's ability and/or will to continue fighting.
Integrated Air Operations	Air power operations integrated with other joint force capabilities to ensure integrated, synchronized cross-component force actions.
Rapid Global Mobility	Operations to move and support men, materiel and assets at speed over strategic distances.
ISTAR	Air power's contribution to the coordinated acquisition, processing and dissemination of timely, accurate, relevant and assured information and intelligence which supports the planning and conduct of operations, targeting and the integration of effects and enables commanders to achieve their goal throughout the Spectrum of Conflict.

Source: (RAF 2005)

Turning the attention to the functional packages for the maritime environment, the 'Future Maritime Operational Concept' (FMOC) expresses the Royal Navy's future view of it being a 'Versatile Maritime Force' (VMF). The FMOC (RN 2003) encapsulates four 'Core Maritime Capabilities' (CMCs), namely:

- Maritime Power Projection
- Flexible Global Reach
- Optimized Access
- Network C4ISR

Maritime Force Projection is defined as "the ability to project force from a maritime force into the territory of another state. It is any deployment of force ashore or the provision of fire to influence events ashore" (RN 2002). Maritime Force Projection is comprised of 'Littoral Manoeuvre' and 'Maritime Strike' (RN 2004). Additionally, Maritime Strike has four components (RN 2002), namely:

- Tactical Air Power
- Land Attack Missile
- Naval Fire Support
- Air Manoeuvre

The Flexible Global Reach core capability, including the sub-component of 'Maritime Leverage', is defined as "the ability to operate and sustain forces world-wide able to swing between roles whilst remaining deployed" (RN 2002). This is concerned with achieving "early, rapid and sustainable effect" (RN 2004). Optimized Access is defined as "the capability, enabled via Swing, to manoeuvre within the open ocean and littoral to project power in support of the Joint battle" (RN 2002). This element consists of three parts: Theatre Entry, Sea Control and Force Protection. The final CMC is that of Networked C4ISR and this is defined as "the sea based contribution to Joint C4ISR, which will enable information superiority, greater situational awareness and a real-time common tactical picture" (RN 2002).

For the land environment, the 'Future Land Operational Concept' (FLOC) "provides the analytical context for future manoeuvre and describes how land formations will operate in 2015" (MoD 2005d). The FLOC's 'Future Manoeuvre Sub-Concept' (FMSC) describe how the British Army will transform into the agile and balanced formation containing a mixture of light, medium and heavy forces (MoD 2005d). Lieutenant-Colonel Constant (2003) states that "the British Army in 2010 will be organized around three capabilities: heavy, medium and light ones". The greatest transformational challenge for the British Army of the future is the development of a 'Medium Weight Capability' (MWCap). General Sir Michael Walker, Chief of Defence Staff, highlighted the real significance of this:

> "*We do not have a medium capability now. We never have. We have been living without this capability. So we should be celebrating the fact that we are bringing one in for the first time in the history of the British Army*" (DefCom 2005b).

The UK's MWCap will be based on four key characteristics (Applegate 2004):

- It must be optimized for rapid effect.
- It is primarily designed for power projection.
- It must have greater combat capability than our current light forces, particularly in the range of effects at its disposal and its ability to sustain these effects over a considerable period.
- Its unique and critical contribution will be in its ability to conduct and exploit rapid effect decisively.

A major contribution to the MWCap will be the FRES platform (MoD 2003a), as described in Section 3.1. In additional to the balancing of LWCap, MWCap and HWCap, two other themes dominate the Army's FMSC: Directed Logistics and ISTAR (Rollins 2005). These are all depicted in Figure 4. The MoD describes the concept of Directed Logistics as representing "an evolutionary shift from supply-based logistics to a leaner, more agile distribution-based" (MoD 2005d) and the individual elements that contribute to a Directed Logistics capability are shown in Table 6.

The grouping together of the components leading to a force structure capability, e.g. FASOC/FMOC/FLOC, corresponds to the MoD's Level 2 capability integration. Overall, the functional packages layer (Figure 4) with the combined inputs from the land, maritime and air environments leads to a Level 3 capability integration where the focus is on integrating the three force structures into the 'Joint Arena' (MoD 2005b). Thus the population of the framework by the three services (British Army, Royal Navy and Royal Air Force) allows each service to consider the future capabilities of the other two and to then explore what this means in terms of inter-service capability.

For example, the Royal Navy's Maritime Force Projection through Littoral Manoeuvre will be significantly influenced by the Army's FLOC in terms of a sea-based joint amphibious force (RN 2004). Additionally, the future VMF will be providing air power from the maritime environment for use on the land as well as the sea. Thus the Maritime Strike element of the Navy's Maritime Force Projection, which "encompasses the ability of the VMF to strike targets at sea and ashore" (RN 2004), will have to consider its inter-relationship with the RAF's FASOC. Correspondingly, the FASOC will have to consider air power operating from the maritime environment. The RAF's vision of an 'Agile Air Force' is intended to encompass "air power elements from all three services integrated to deliver future air and space power" (RAF 2005). This is even termed AP^3 (air power through the 3 services).

Table 6: Directed Logistics capability elements

Whole Fleet Management	Whole Fleet Management (WFM) is the process of managing a fleet of equipment through global visibility in the most supportable effective and economic manner in order to meet stated operational, training and support requirements.
Total Fleet Requirement	The Army's Total Fleet Requirement (TFR) is the total number of vehicles, weapon systems, ancillaries, equipments and supporting equipments required to deploy on the Most Demanding Defence Operational Liability concurrently.
Contractor Support to the Army on Deployed Operations	CONtractor on Deployed Operations (CONDO) is the generic term covering use of contractors and the means of contractorisation of functions on operations.
Intermodality	Intermodality is the integrated use of all modes of transport to effect the timely, seamless and efficient movement of goods and services.

Source: (MoD 2005d)

5. Effects layer

The third layer in the capability framework (Figure 1) integrates the effects-based approach whereby an effect is seen as a capability in its own right. The Rt Hon Geoff Hoon, previous UK Secretary of State for Defence, stressed the need to consider military effects in order to have a fuller picture of defense capability:

> "*We must therefore move away from always assessing defense capability in terms of platforms or unit numbers. It is now more useful to think in terms of the effects that can be delivered - we must consider what effect we want to have on an opponent and at what time*" (Hoon 2003).

At the strategic level, the MoD has identified eight high-level 'Strategic Effects' (MoD 2003c) which range from 'Prevent' to 'Destroy'. These are plotted on the capability framework as illustrated in Figure 5. The 'Prevent' effect is defined by the MoD (2003c) as the capability "to stop or limit the emergence and development of crisis and conflict through fostering regional and national security by helping to:

- Address the underlying causes of instability, such as poor governance, political repression, social inequality and economic hardship.
- Implement agreements to reduce weapons proliferation, particularly WMD.
- Encourage and assist with security sector reform.
- Build local capacity to deal with emerging crises.

- Encourage the international community to act against emerging crises."

Whereas the 'Destroy' effect is the capability "to so damage an enemy state or nonstate adversary that he is no longer militarily viable" (MoD 2003c). This effect also includes "the removal of an enemy's military capability or the elimination of terrorist organizations" (MoD 2003c). The MoD points out that the 'Destroy' effect goes beyond the 'Defeat' effect by "ensuring that there remains no real immediate potential for the adversary to return to conflict" (MoD 2003c). To illustrate the application of these effects in terms of capability, consider: what are the effects that the MoD and Armed Forces need in order to construct a response to the threat from international terrorism? Figure 6 depicts the MoD's response to this question. Their approach to countering terrorism is based on the effects of prevent, deter, coerce, disrupt and destroy (DefCom 2003).

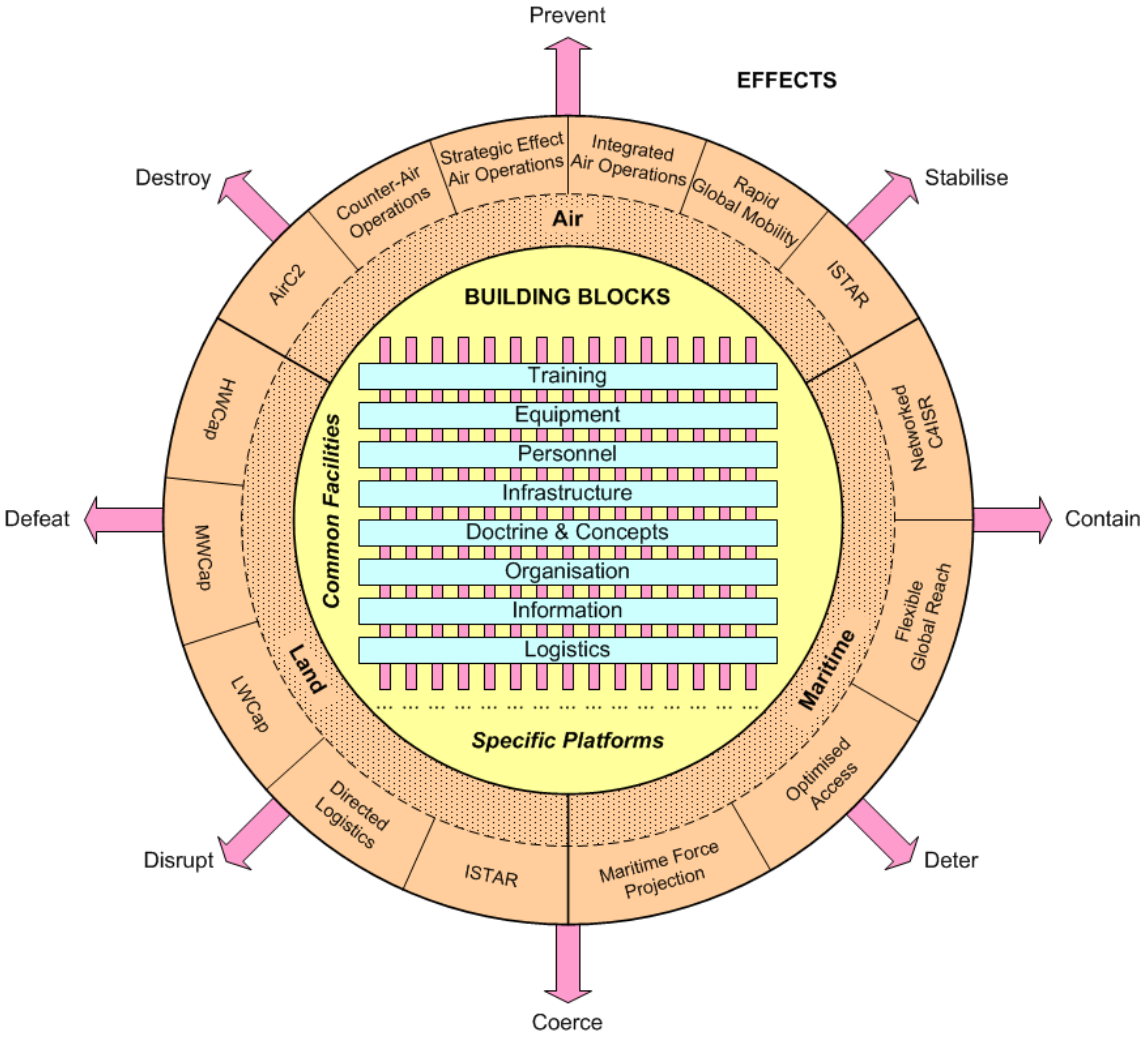

Figure 5: Building blocks, functional packages and effects

It should be noted that the future functional packages in Layer 2 of the framework must, as a whole, contribute to the full spectrum of the strategic effects contained in Layer 3. For example, the Royal Navy's future vision of its Versatile Maritime Force (VMF) will contribute in full to the eight high-level strategic effects (RN 2004). In terms of operationally achieving military effects, the capability framework can also embody the MoD's joint 'High Level Operating Concept' (HLOC). This actually provides a direct link from the functional packages layer to the effects layer in that it can determine the operational effects which can be realized from each of the individual functional packages and as such

highlight their contribution to the strategic effects. The HLOC identifies seven operational effects that underlie operational defense capability (MoD 2004). These are:

- Command
- Inform
- Operate
- Prepare
- Project
- Protect
- Sustain

As an illustration of the link between the functional packages and the strategic effects (Figure 5) Table 7 portrays the operational effects, as embodied in the HLOC, that can be realized from each of the maritime functional packages.

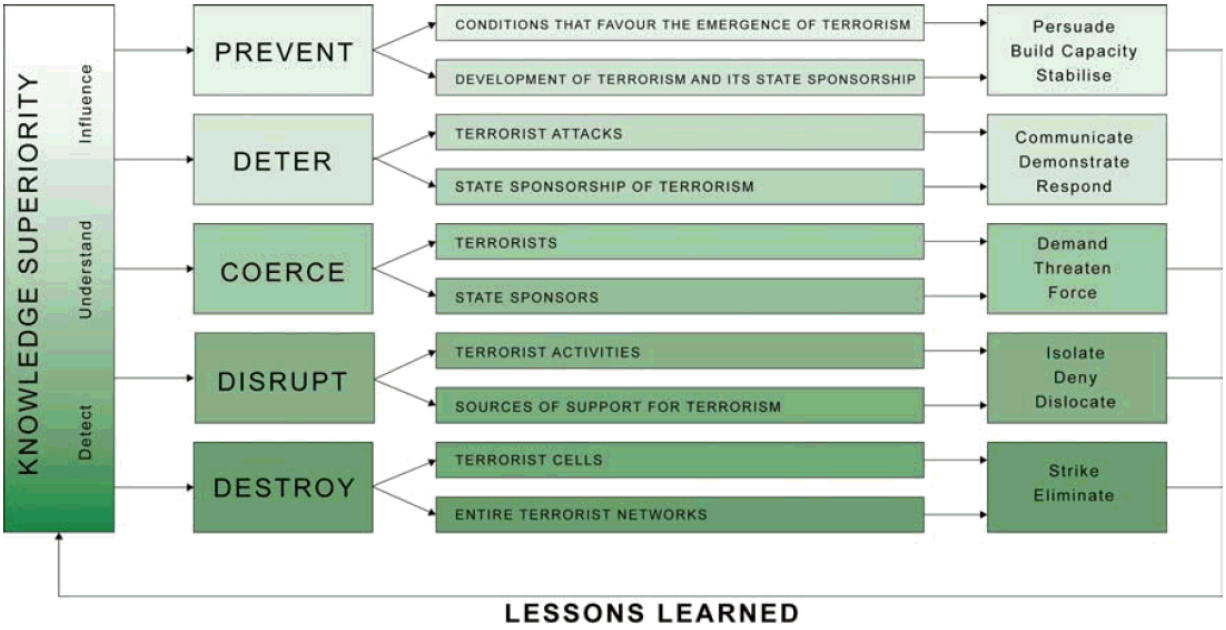

Figure 6: Conceptual approach to countering terrorism (DefCom 2003)

Table 7: Operational effects from the maritime functional packages

Maritime Force Projection	Command, Operate, Project, Protect
Optimised Access	Command, Inform, Operate, Prepare, Project, Protect, Sustain
Flexible Global Reach	Command, Operate, Project, Sustain
Networked C4ISR	Command, Inform

Source: (RN 2004)

6. Influencers layer

The final layer in the conceptual framework that must be populated in order to derive a visual representation of the UK's future military capability is the influencers layer. This layer encapsulates the elements that influence or drive the defense transformation process. Essentially the influencers layer combines the instruments of power (military, diplomatic, economic) that have a direct bearing on the future effects, future functional packages, future common facilities and future platforms. Figure 7 depicts the five categories that influence capability.

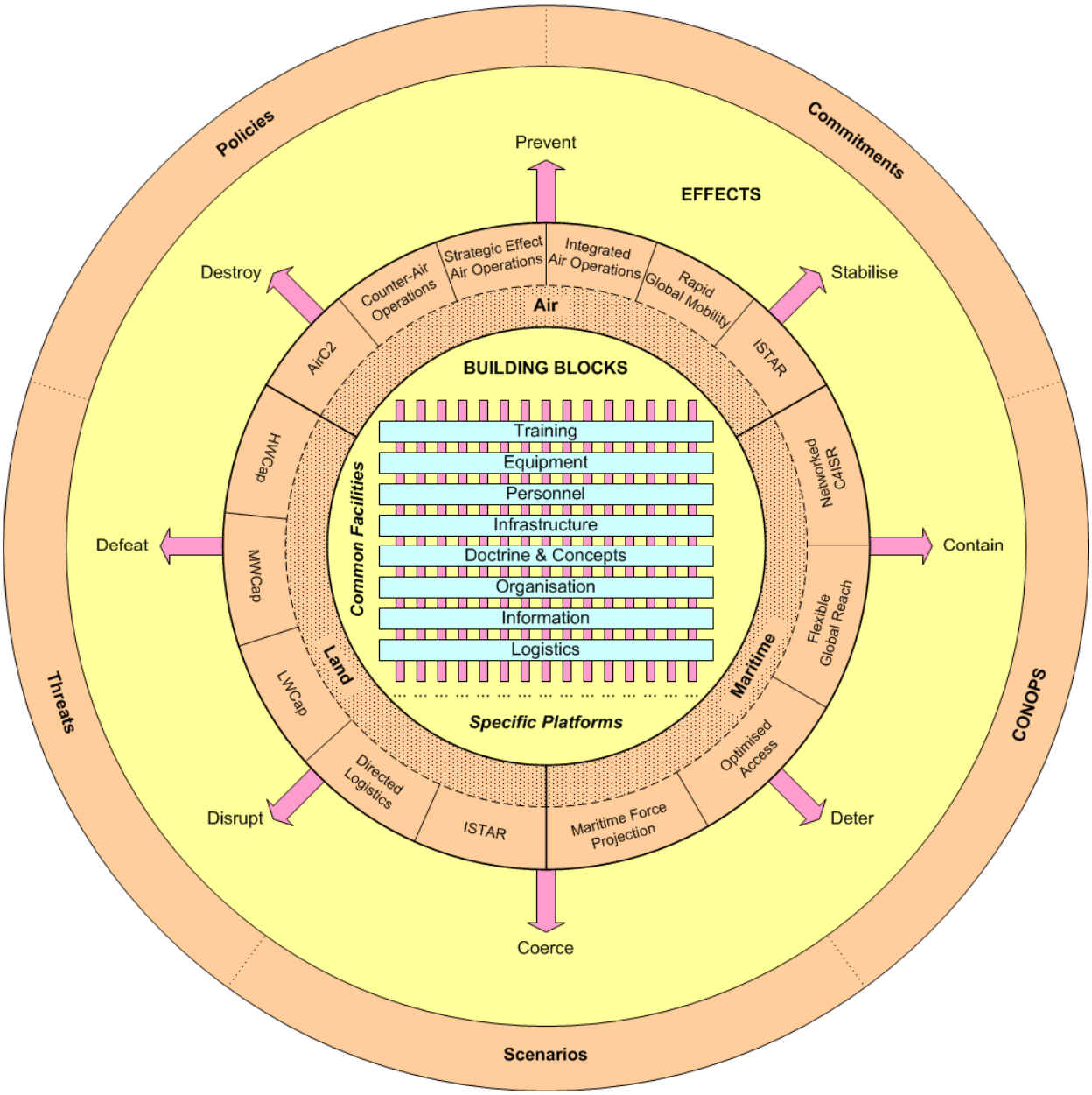

Figure 7: Building blocks, functional packages, effects and influencers

The development of future military capability must be aligned with developments in government/defense policy. Policy "guides the contribution the Armed Forces make to the achievement of the country's defense and security goals and shapes their structure and capabilities" (British Army 1996). At the highest level of policy, the foremost military capability is to "maintain the freedom and territorial integrity of the United Kingdom and its Dependent Territories, and the ability to pursue its legitimate interests at home and abroad" (British Army 1996). The UK's defense policy is defined in terms of three overlapping roles (British Army 1996):

- Defense Role 1 – To ensure the protection and security of the United Kingdom and her dependent territories even when there is no external threat.
- Defense Role 2 – To ensure against major external threat to the United Kingdom and her allies.
- Defense Role 3 – To contribute to promoting the United Kingdom's wider security interests through the maintenance of international peace and stability.

Through these three broad general roles, the MoD must meet specific commitments. For example, the MoD must provide the capability to perform 18 'Military Tasks' as categorized under the four generic headings of Standing Strategic Commitments, Standing Home Commitments, Standing Overseas Commitments and Contingent Operations Overseas (MoD 2003c). The specific tasks are outlined in Table 8.

Table 8: Military tasks

Standing Strategic Commitments	Standing Home Commitments	Standing Overseas Commitments	Contingent Operations Overseas
1. Strategic intelligence 2. Nuclear deterrence 3. Hydrographic, geographic and meteorological services	4. Military aid to the civil authorities 5. Military aid to the civil power in Northern Ireland 6. Integrity of UK waters 7. Integrity of UK airspace 8. Public duties and VIP transport	9. Defence and security of the overseas territories 10. Defence and security of the sovereign base areas of Cyprus 11. Defence diplomacy, alliances and support to wider British interests	12. Humanitarian assistance and disaster relief 13. Evacuation of British citizens overseas 14. Peacekeeping 15. Peace enforcement 16. Power projection 17. Focused intervention 18. Deliberate intervention

In terms of commitments, the UK has declared forces to NATO. For example, the British Army's contribution consists of (British Army 1996):

- Immediate Reaction Forces such as the Allied Command Europe Mobile Force (Land) [AMF(L)]
- Rapid Reaction Forces, of which the UK Land component comprises the contribution to the Allied Rapid Reaction Corps (ARRC), one armored and one mechanized division and an airmobile brigade
- Main and Augmentation Forces held at the lowest state of readiness
- Special Forces

Additionally, Concepts of Operations (CONOPS) will have an influence over the development of future capabilities. For example, the concept of concurrent small scale operations will represent "force drivers for specific capabilities" (RN 2002). There are a number of constants in the British Doctrine that impact capability such as the principles of war, manoeuvrist approach and warfighting ethos. Additionally, there are the changes to effects-based operations, greater agility, decision superiority and shared situational awareness that directly drive the transformation of military capability. The MoD is also working to the assumption that British Forces will be operating "alongside US Forces for large-scale warfighting operations" (MoD 2004). A clear driver for defense transformation are the future concepts based on coalition force interoperability:

> "*There is no doubt that the bulk of operations conducted by Western democracies will certainly be of a joint, interdepartmental, inter-agency and multinational nature*" (Rollins 2005).

The development of the UK's future military capability aligned with coalition force interoperability represents the highest level of capability integration for the MoD. This Level 4 "aims to achieve capability integration with allies" (MoD 2005b). In terms of applying the capability framework, this

would involve determining the linkages between the UK's visualization of future military capability, as shown in Figure 7, to the respective visualizations of other coalition members. These other defense forces can also adopt the capability framework presented in this paper to populate their future military capabilities around the effects, functional packages, common facilities and platforms.

Future capabilities, of course, must be able to respond to any future threats. This category of influencer can be illustrated by an example from the Royal Navy (RN 2002); who have considered the threats that their future functional packages, in Figure 4, must contend with. These threats include:

- Offensive underwater warfare, i.e. threats from submarines, mines, torpedoes
- Offensive surface warfare, i.e. threats from fast inshore attack craft, missile boats, sophisticated high performance offensive weapon systems
- Offensive air warfare, i.e. threats from aircraft, missiles (supersonic and emergent hypersonic)
- Computer network attacks (threats from cyberspace)
- Weapons of Mass Effect (WME)
- Novel explosives and EMP weapons
- Asymmetric attacks

All of the influencers can be combined in a set of future scenarios. The transformation of defense capability must then be aligned to such scenarios. For example, seven classes of scenario have been identified by the British Army (1996). These include:

- Military aid to the civil power in the United Kingdom.
- A challenge to the internal or external security of a dependent territory.
- General war, e.g. a large scale attack against NATO.
- A limited regional conflict involving a NATO ally who calls for assistance under Article V of the Washington Treaty.
- A British contribution to the missions of NATO and the WEU.
- A serious conflict (but not an attack on NATO or one of its members) which, if unchecked, could adversely affect European security, or which could pose a serious threat to British interests elsewhere, or to international security.
- Other military assistance and limited operations, characteristically of lower intensity and longer duration, to support international order and humanitarian principles, often under United Nations auspices.

The development of specific scenarios under these seven classes is a key part of long-term defense planning (LTDP). The question that should be pursued is: what portfolio of future platforms, common facilities, functional packages and effects must be developed in order to satisfy the requirements of such capability-driven scenarios?

7. Summary

This paper started with a quotation from Lord Robertson, NATO's 10th Secretary General, stressing capability as a priority for the defense community. It is also appropriate to end this paper with another quotation from Lord Robertson:

"*In today's dangerous world, there is no credibility without capability*" (Robertson 2000).

This paper has presented a framework to fully represent the abstract concept of 'capability'. A case study based on the United Kingdom's Ministry of Defence (MoD) has been used to illustrate how the

framework can be applied in practice and how it should be populated. The principal aim of using the framework is to develop a single visual representation of future military capability between the three broad stakeholder groups of warfighter, government and industry. The generic architecture of the framework consists of four concentric layers:

1. Building blocks (strategic platforms and common facilities)
2. Functional packages (force structures and environments)
3. Effects (strategic, tactical and operational)
4. Influencers (policy, commitments, threats, scenarios and concept of operations)

The utilization of the framework allows the three stakeholder groups to have a shared understanding of what will constitute future military capability. Additionally, the different service branches of the military can both explore and determine their degree of commonality and inter-service capabilities. The concentric layers also allows traceability between the three perspectives of capability, e.g. from the platforms through to their assignments in functional packages and their resultant employment to achieve effects. Ultimately, the application of the framework is intended to allow the stakeholders to enter discussions of what capabilities are needed in the future and to develop a visual representation of those future capabilities such that a shared understanding can be reached. The mapping of capabilities onto the framework then allows the stakeholders to develop their transformation roadmaps and synchronize the associated capability development plans – this next stage is currently the subject of on-going research.

References

Ankersen, C. (2005) Capabilities and capacities. In: Transforming national defence administration, Edited by D. L. Bland, pp. 11-17. Ontario: Queen's University School of Policy Studies. ISBN: 1-55339-117-9.

Anon (2005) Future rapid effect system. Defence Management Journal, 28, pp. 56-57.

Appathurai, J. (2002) Closing the capabilities gap. NATO Review, Autumn 2002, pp. 2-4.

Applegate, D. (2004) Delivering the medium weight capability. RUSI Defence Systems, 7 (2), pp. 56-59.

Atkinson, S. R. & Moffat, J. (2005) The agile organization: From informal networks to complex effects and agility. The Command and Control Research Program - Information Age Transformation Series. Virginia: CCRP Publications. ISBN: 1-893723-16-X.

British Army (1996) Design for military operations - The British military doctrine. Report Number: 71451, The British Army, United Kingdom.

Burridge, B. (2004) Developing tomorrow's air power today. RUSI Defence Systems, 7 (2), pp. 76-78.

Constant, L. (2003) The British army by 2010. Doctrine - General military review, 1, pp. 46-49.

DefCom – House of Commons Defence Committee (2003) A new chapter to the strategic defence review. Report Number: HC 93-I, The Stationery Office, London, United Kingdom. ISBN: 0-21-501071-X.

DefCom – House of Commons Defence Committee (2005a) Future Capabilities: Volume I. Report Number: HC 45-I, The Stationery Office, London, United Kingdom. ISBN: 0-21-502278-5.

DefCom – House of Commons Defence Committee (2005b) Future Capabilities: Volume II. Report Number: HC 45-II, The Stationery Office, London, United Kingdom. ISBN: 0-21-502282-3.

DSB/DSAC – Defense Science Board / Defence Scientific Advisory Council (2006) Defense critical technologies. Defense Science Board, The Pentagon, Washington, United States of America. http://www.acq.osd.mil/dsb/reports/2006-03-Defense_Critical_Technologies.pdf Last accessed: 6th April 2006.

Emery, V. (2005) Delivering naval capability through smart acquisition: The UK's type 45 destroyer programme. RUSI Defence Systems, 8 (2), pp. 84-88.

Hoon, G. (2003) Keynote address. Transforming defence in the 21st century - Opportunities and constraints, The Royal Institute of International Affairs, Chatham House, London, March 10-11, 2003.

Jermy, S. (2004) Maritime air power. RUSI Defence Systems, 7 (2), pp. 84-87.

Mark, B. (2004) Defence logistics - The challenge of effectiveness and efficiency. RUSI Defence Systems, 7 (2), pp. 30-31.

MoD – Ministry of Defence (1999) British Air Power Doctrine. Report Number: AP 3000 [3rd Edition], The Stationery Office, London, United Kingdom. ISBN: 0-11-887310-5.

MoD – Ministry of Defence (2003a) Delivering Security in a Changing World: Defence White Paper. Report Number: Cm 6041-I, The Stationery Office, London, United Kingdom. ISBN: 0-10-160412-2.

MoD – Ministry of Defence (2003b) Capability audit. Acquisition Management System, The Ministry of Defence, United Kingdom. http://www.ams.mod.uk/ams/content/docs/capaudit/capaudit.htm Last accessed: 9th March 2006.

MoD – Ministry of Defence (2003c) Delivering Security in a Changing World: Supporting essays. Report Number: Cm 6041-II, The Stationery Office, London, United Kingdom. ISBN: 0-10-160412-2.

MoD – Ministry of Defence (2004) The UK joint high level operational concept. Report Number: Joint HLOC, The Joint Doctrine and Concepts Centre, Ministry of Defence, Shrivenham, United Kingdom.

MoD – Ministry of Defence (2005a) Defence industrial strategy. Report Number: Cm 6697, The Stationery Office, London, United Kingdom. ISBN: 0-10-166972-0.

MoD – Ministry of Defence (2005b) Army customer two handbook (2nd Edition). Report Number: GS/2/5 (DCI(A)), The Ministry of Defence, United Kingdom.

MoD – Ministry of Defence (2005c) The acquisition handbook (6th Edition). The Ministry of Defence, United Kingdom.

MoD – Ministry of Defence (2005d) Army doctrinal underpinning. Acquisition Management System, The Ministry of Defence, United Kingdom. http://www.ams.mod.uk/ams/content/docs/sse/domain/land%20environ%20guidance/doctrine.htm Last accessed: 5th April 2006.

NAO – National Audit Office (2002) Building an air manoeuvre capability: The introduction of the Apache helicopter. Report Number: HC 1246, The Stationery Office, London, United Kingdom. ISBN: 0-10-291831-7.

NAO – National Audit Office (2003) Through-life management. Report Number: HC 698, The Stationery Office, London, United Kingdom. ISBN: 0-10-292153-9.

NAO – National Audit Office (2005) Ministry of Defence major projects report 2005. Report Number: HC 595-I, The Stationery Office, London, United Kingdom. ISBN: 0-10-293625-0.

RAF – Royal Air Force (2003) Royal Air Force aircraft and weapons. The Royal Air Force, United Kingdom.

RAF – Royal Air Force (2005) Future air and space operational concept. Report Number: FASOC, The Royal Air Force, United Kingdom.

RN – Royal Navy (2002) Future navy - Operational concept. Report Number: NAVB/P(01)13, The Royal Navy, United Kingdom.

RN – Royal Navy (2003) Naval Strategic Plan. The Royal Navy, United Kingdom.

RN – Royal Navy (2004) Future maritime operational concept. Report Number: NAVB/P(04)2, The Royal Navy, United Kingdom.

Robertson, G. (2000) NATO in the 21st Century. Speech by the Secretary General to the Millennium Year Lord Mayor's Lecture, London, July 20, 2000. http://www.nato.int/docu/speech/2000/s000720a.htm Last accessed: 30th March 2006.

Rollins, J. (2005) The British army's contribution to modern operations. Doctrine - General military review, 7, pp. 49-53.