The Development of a Coalition Operational Architecture: A British and US Army Approach

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Abstract

In January 1999 after discussions between staff from the UK's Command Support Branch, Directorate General of Development and Doctrine (DGD&D) and the US Army's TRADOC Program Integration Office Army Battle Command Systems (TPIO-ABCS) at Fort Leavenworth. It was agreed that the possibility of developing a Coalition Operational Architecture (COA) to support a US Corps operating as a Combined Joint Task Force (CJTF) Headquarters with up to a UK Division as an integral part of its ORBAT would be investigated by staff from both countries Army Operational Architecture (AOA) teams. The initial work was completed by August 1999 The paper sets out how the work was progressed using both the model that was built using the UK's Soft Systems Methodology and the utilisation of US Army IDEF0[1] models. Key issues that should be addressed in coalition operations are highlighted and it recommends how this work should be taken forward to support the issue of C2 interoperability in coalition operations of the future. The initial results were presented to the US-UK Staff Talks in September 1999. An agreement in principle to further develop the COA was agreed but resource priorities have meant that the next phase of work is yet to begin.

1. Introduction

Both the US and UK's AOA teams have been exchanging information on their respective approaches to developing an Operational Architecture (OA) since December 1995, when the UK

[1] Integrated Definition Language.

AOA staff made their first visit to TPIO-ABCS AOA staff at Fort Leavenworth to see how the US were developing their OA as the British Army were about to embark on developing its own.

In the US the Clinger-Cohen Act of 1996 mandates that the Services develop and incorporate architecting into their requirements and acquisition process for any information technology (IT) initiatives. The US Army established the Army Enterprise Architecture (AEA) to satisfy this IT requirement. The AEA directed that three (3) architecture views be used. Those three views are OA, Systems Architecture (SA) and Technical Architecture (TA). In the UK no such mandate was directed but it was agreed that three similar architectures would be developed to support the UK's Digitization of the Battlespace (Land) programme. The US definitions for their three architectures are below:

- OA is the total aggregation of missions, functions, tasks, information requirements, and business rules. A description (often graphical) of the operational elements, assigned tasks, and information flows required to accomplish or support a warfighting function. It is required for input for SA development.
- SA is the physical implementation of the OA. It is the layout and relationship of systems. It describes how to achieve the functions of the OA.
- TA is the "building codes" upon which systems are based. It identifies the standards and controls to attain and maintain interoperable IT capabilities.

The UK definition of its AOA was that:

"The Army Operational Architecture is a strategic statement of goals and objectives for the development of Army information systems (IS). The architecture will include concepts of use in support of Army Doctrine and a high level framework of user activities, services, information needs and logical connectivity."[2]

From the US perspective the AEA contributes to the Warfighter capability as an enabler for achievement of fast and efficient (accuracy is dependent on the person who puts the information into the system) information flows. The OA provides a disciplined and documented approach to linking military strategy and doctrine to the employment of technology used in executing military operations, developing an investment strategy, managing C4ISR complexity, redundancy of functions and information requirements, and development of future requirements. This essentially was the same for the UK although we do not benefit from an act that enforces architecture work as a prerequisite for acquisition of new information systems.

In the US the mandated use of IDEF0[3] also provided a common activity/process modeling methodology, which was relatively well understood and non-proprietary. The US Army OA was initially developed to support their Force XXI initiative developing both "as-is" and "to-be" models of the constituent elements of their initial digitized formations and units. The models

[2] The definition was endorsed by the Army Information Systems Strategy (AISS) 1996, which was approved by the Army Policy and Resources Committee (APRC) in August 1996.

[3] AR 25-1 Army Information Resources Management Program, AR 25-9 Army Data Management and Data Standards Program etc specify the use of IDEF Information Modelling for a number of analysis-modelling activities. Federal Information Processing Standard (FIPS) 183 is the laid down standard for IDEF 0 Activity Modelling.

developed were detailed and rigorous. In addition at that time a data model was being built to support their activity modeling.

Although an option for the UK was to adopt the US approach, which would have enabled the UK to utilize the modeling conducted by the US Army and would have meant that both nations were using a common language to support the process. A number of factors precluded this approach:

- It was felt that in order to understand the complexities of Army IS the UK's AOA would have to take an Army-wide view and incorporate both the operational and support elements of the Army. This was in contrast to the US Army's initial programme, which at that stage looked only at the battlefield.
- IDEF0 generates a considerable amount of detail, which would have been difficult to maintain in the UK due to limited resources.
- The UK programme lacked at that stage the resources to match the US Army initiative.
- Due to the decentralized structure of Defence budgets within the different budgetary areas of the British Army the AOA had to ensure that the stakeholders were involved in the process and could take ownership of the end product.
- Digitization of the battlefield was broken down into three stages[4] and in order to influence the latter stages of this initiative the development of an "as-is" model of the Army was considered inappropriate. Therefore any model had to be independent of organizations, current procedures, scenarios and technology. In addition the model had to be durable and easily maintained. The latter point reflected the fact that "business" models had been developed before but were overcome by organizational change, which undermined the validity of the models.
- Unlike the US Army operational architecture the UK AOA had no responsibility for developing a Data Model, which in the UK was then the responsibility of the Army Communications and Information Systems Authority (ACISA)[5].

The UK's approach after evaluating several methodologies including IDEF0 was to adopt the Soft Systems Methodology (SSM). Details of this methodology were given in a paper at the 1998 CCRTS in Monterey[6]. A description of SSM is included at Appendix 1.

Work in the US has lead to the development of a number of models to support their digitization efforts and in developing the UK's initial models[7] these models were utilized to cross check the UK's own work and to further develop what the UK describe as information categories. These are effectively a hierarchy of information objects, which if taken to their lowest level would become data elements. Further work is now taking place to further refine and add the inputs and

[4] The UK Digitization programme was initially broken down into three stages based on certain timeframes which evolved around development of key equipment programmes; Stage 1 (1997-2002), Stage 2 (2003-2008) and Stage 3 (20009-2015). The UK's AOA was not in a position to influence Stage 1 but wanted to influence Stage 2 and beyond.
[5] This is now Army Data Services (ADS).
[6] 'Developing the United Kingdom's Army Operational Architecture'
[7] The UK initially developed four models reflect the complexity of war fighting at both ends of the spectrum of military conflict and the ability of the Army to deliver military capability. These were; High Intensity Conflict, Peace Support Operations, a 'Business' model on the delivery of military capability and a model on Sustaining the Individual.

outputs from an activity using an information catalogue which holds the information categories developed to date.

2. The Purpose of the COA

The purpose of developing a US - UK COA is a step toward the digitization and refinement of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) interoperability requirements. In this specific example, it is based on existing OA products from each army and the build of additional products to meet specific coalition requirements for interoperability and digitization. Each AOA was produced using the same theory and intent, but with different tools and methodologies. The intent of this paper is to generate thought and discussion on how Coalition functions, information requirements (IRs) and performance parameters must be integrated to enable the appropriate systems to interoperate. This should be able to satisfy the warfighter's C4ISR mission requirements in a coalition environment.

2.1 *The Approach*

To date initial efforts have focused at the action officer level. A meeting between both teams was held in the UK in March 1999. The aim of this meeting was to develop an approach to the work and at the same time present the different methodologies used by both teams. In order to scope the problem and provide a clearer understanding of the work required to be carried out it was decided to use SSM as this would also serve as a means for the US members of the team to become more familiar with SSM. This work lead to the development of an SSM model that mapped out the activities that the team would be required to undertake in order to produce a COA. The top-level structure of the model is shown in Figure 1 below:

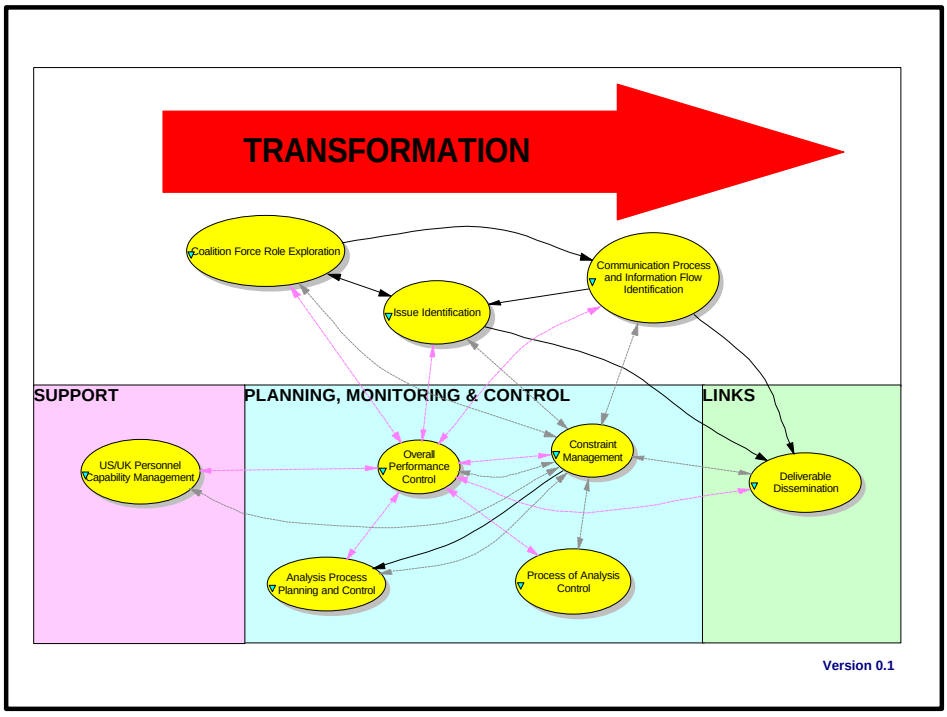

Figure 1 – Top Level Enterprise Model for Developing the US-UK COA.

This process enabled the team to decide on what were the key activities that were necessary and the mechanisms that needed to be in place to ensure that Phase 1 could be delivered by the September 1999 UK- US Staff Talks. One of the initial issues that had to be resolved was what modeling methodology should be used. The US AOA team were mandated to use IDEF0, an option the UK had decided on at an early stage in developing their AOA not to follow.

After considerable deliberation it was decided that the UK's SSM model – the Army Activity Model (AAM) because it had been developed as a conceptual model and cover a much wider set of activities, would be used to identify key issues. In order to identify the information flows between the US Corps and a UK Division, the US IDEF0 models that had been developed to support III US Corps and the US Digitized Division would be used as the starting point for this aspect of the work.

2.2 *Agreed Tasks*

It was agreed that we would analyze several key objectives in the context of OA:

- Tempo and Battle Rhythm.
- Unity of Command and Effort.
- Synergy between key battlefield winning assets.
- Identification of the key enablers.
- Determine what is needed to support "Interoperability of the Mind".

Issues related to these objectives would be expressed in the context of what the US call DTLOMS[8] and the UK Lines of Development (LOD)[9]. In addition the US AOA Team agreed to develop their Corps C2 Model down to three levels of decomposition to reflect the Corps HQ acting as a CJTF HQ and produce a draft operational and organizational concept. These concepts and organizational structures do not necessarily reflect the thinking of either countries military leadership but would form the basis of our initial modeling efforts.

3. **Combined Joint Task Force Operational and Organizational Concept**

The following are some initial thoughts on the construct and concept for a US/UK Coalition OA.

3.1 *General*

The scenario used in this analysis incorporates a mid-intensity combat operation involving the ground, naval, and air forces of the US and UK. The US and the UK are operating in an *ad hoc* coalition outside the NATO alliance.

The US III Corps is the basis of a CJTF headquarters. The corps headquarters has been augmented with US and UK air and naval officers. The UK has appointed a National Contingent

[8] Doctrine, Training, Leadership, Organization, Materiel and Soldiers.
[9] Lines of Development are based on Concepts and Doctrine, Equipment and Technology, Structures, Sustainability, People and Training Development each of which has a proponent responsible for addressing the issues affecting their area.

Commander (NCC). Figure 2 shows the organization of the CJTF headquarters with the joint boards and centres to be employed.

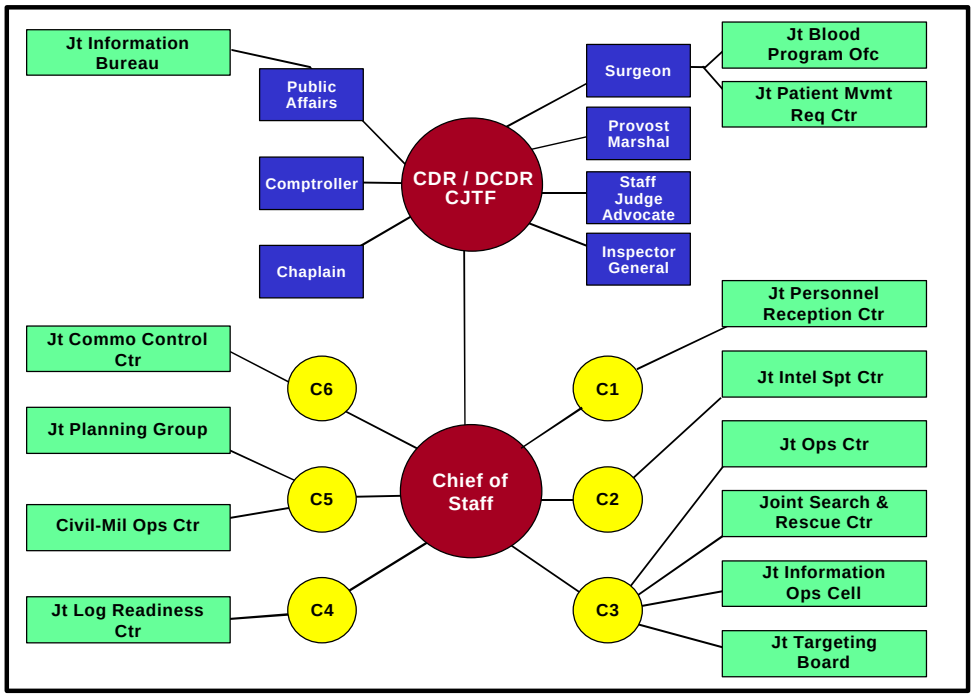

Figure 2 - Coalition / Joint Task Force Headquarters Organization

The corps has no fixed organization. Its composition is tailored to fit its assigned role, mission, and the general situation. This analysis assumed the ORBAT shown in Figure 3.

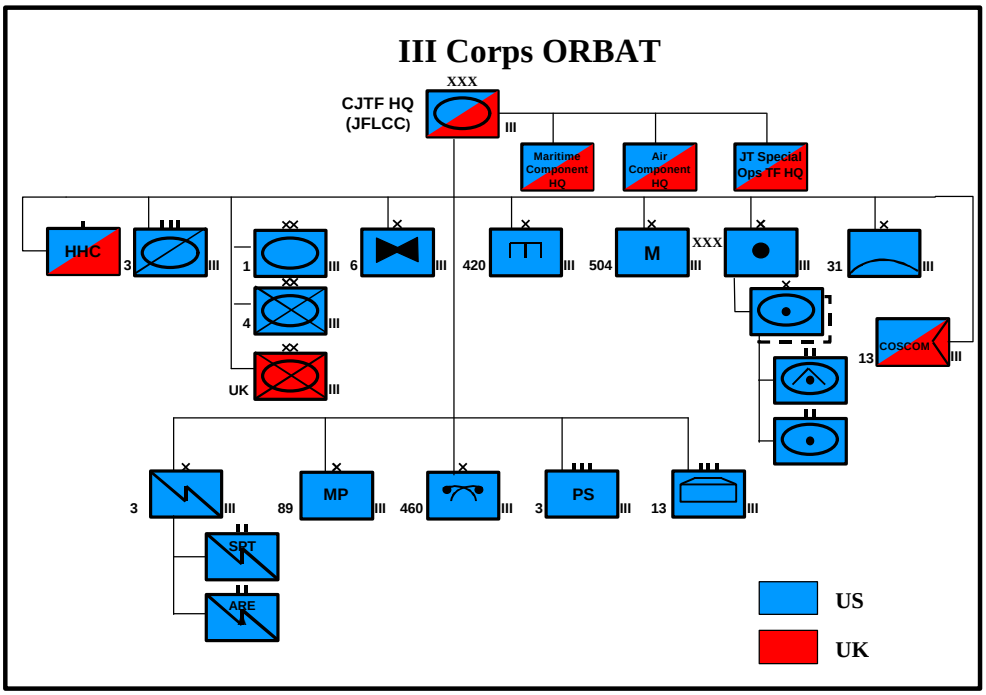

Figure 3 – Possible ORBAT of Coalition / Joint Task Force

3.2 *Operational Concept*

The CJTF will employ split-based operations, with intelligence and communications support provided from an aerial port of embarkation (APOE), seaport of debarkation (SPOD), or intermediate staging base (ISB). Split-based logistics may be employed to some degree, but excessive dependence on split-based logistics may adversely influence Combat Service Support (CSS) and operational capabilities.

The CJTF will operate within a physical region, known as battlespace, which is determined by the maximum capabilities of friendly and enemy forces, to acquire and dominate each other by fire and maneuver in the electromagnetic spectrum. CJTF maneuver elements conduct operations exclusively within this battlespace. CJTF support elements will also conduct sustainment operations within this battlespace. However, CJTF support elements, based on the factors of Mission, Enemy, Terrain, Time - Troops available and Civilians (METT-TC), may find themselves physically located at an ISB or positioned within a designated sanctuary outside the CJTF battlespace and beyond the enemy's ability to employ fires and maneuver. The corps-based CJTF headquarters will normally locate within the battlespace, with a tactical command post (Tac CP), a main command post, and a rear command post.

The CJTF maximizes use of information technologies to dramatically increase the synergy of its combined arms organization. Improved situational awareness, shared by subordinate combat, combat support, and CSS units, enables the CJTF to avoid enemy strengths and combine the friendly effects of joint fires and maneuver to seize and retain critical terrain or destroy high-payoff targets. The situational awareness available to the CJTF coupled with state-of-the-art acquisition and tracking systems, improved precision indirect fire munitions. Even more lethal aerial platforms, enables it to conduct decisive combat operations at the time and place of the commander's choosing.

Significantly improved connectivity will enable the CJTF to bring the full weight of the coalition joint team to bear at the decisive time and place.

The CJTF headquarters element located in the battlespace is execution focused. It sequences, synchronizes, directs, and reinforces the actions of its subordinate and supporting elements to accomplish the overall objective. It possesses multiple staff elements that facilitate the conduct of continuous high-tempo operations through rotation of key personnel. All levels of the CJTF synthesize situational awareness provided by national, theater, and joint platforms, as well as information gathered by organic reconnaissance assets. The CJTF commander emphasizes the capture of near real time information. The CJTF ground command and control (C2) platforms and nodes are mobile and capable of C2 on the move. In addition, they are equipped with secure communications, sophisticated long-range voice, digital, non-line-of-sight, and satellite communications (SATCOM). The CJTF headquarters has direct links to combined and joint intelligence, C2, fires, and logistics networks. The CJTF commander and his immediate subordinate commanders have complementary C2 capabilities which allows the direct employment of combined and joint assets in support of distributed operations at geographically distinct points on the battlefield.

Superior situational awareness is essential to the success of the CJTF. It enables the CJTF to quickly develop the situation, take decisive action, conduct maneuver, and employ precision fires to their fullest effect within a compressed period of time. The CJTF possesses organic ground and aerial reconnaissance assets, which ensure it, can achieve information superiority by creating a significant disparity between friendly and enemy awareness of the battlespace. Cued by national, joint, and tactical surveillance systems, the commander commits CJTF reconnaissance systems to gain information to facilitate the defeat or destruction of threat systems. Wide-area surveillance platforms and organic reconnaissance assets are central to the force protection scheme. They enable the CJTF to avoid giving a superior enemy force an opportunity to synchronize a combined arms assault against it. Situational awareness also facilitates effective C2 and CSS and permits the CJTF to maintain a dispersed and mobile footprint designed to minimize the effects of threat weapons of mass destruction (WMD), aerial fires, area munitions, and precision weapons.

The CJTF will execute continuous, high-tempo combat operations, employing maneuver and operational fires, facilitated by its ability to gain superior situational awareness. It will defeat enemy forces by dislocating their battlefield operational systems, as well as by seizing and holding key terrain. When augmented, it can also conduct stability and support operations. The CJTF achieves decisive results by using a combination of maneuver, asymmetrical tactics, indirect approach, information operations (IO), and precision fires to defeat the enemy at one or more decisive points. It masses organic, assigned, and attached effects and the effects of other services rather than platforms. The CJTF is able to mass effects by exploiting the potent combination of enhanced C2 capabilities, precision munitions, and extended-range direct fires. The CJTF is configured to quickly assimilate other Army, joint, or multinational capabilities to include psychological operations (PSYOPS), civil affairs (CA), military police (MP), air defense (AD), engineer, and IO support elements.

The CJTF features centralized CSS. Most CSS functions are consolidated under the command and control of a central headquarters. This consolidation allows for adequate support while reducing the overall numbers of CSS soldiers in the CJTF, yet retains the ability to surge assets when necessary. The CSS concept uses a common operational picture of the battlefield to better anticipate support requirements and maximizes battlefield distribution, which requires fewer stocks forward. This maximizes throughput distribution, which in turn increases the speed that personnel, supplies, and services move through the CSS pipeline to the supported unit. Joint, multinational, and host nation CSS is also utilized to the greatest extent possible. The bulk of the CSS provided to the CJTF may arrive via secure ground lines of communications. However, the CJTF is prepared to employ airlines of communications, particularly for critical personnel, bulk fuel (class III), ammunition (class V), major end items (class VII), and repair parts (class IX).

The defining capabilities of the CJTF are listed below:

- **Protect the Force**. Situational awareness, enhanced defensive capabilities, and dispersion protect the CJTF from the effects of threat WMD, indirect fires, and air attack. The reconnaissance capabilities of the CJTF safeguard it by protecting friendly forces against defeat in detail in a contiguous and non-contiguous environment. The CJTF is

capable of operations in an NBC environment, however, if the CJTF cannot avoid NBC contaminated areas, it must be provided with deliberate decontamination assets.

- **Gain Information Superiority**. The CJTF achieves information superiority by collecting, processing, and disseminating an uninterrupted flow of information while denying an adversary the ability to do the same. The CJTF utilizes Information Operations (IO), as well as joint and organic information gathering capabilities, to quickly achieve superior situational awareness, which serves as the first step to gaining information superiority at critical points during combat operations.

- **Shape the Battlespace**. The CJTF shapes the battlespace in preparation for decisive operations. It employs joint and coalition forces in support of the campaign plan. By shaping the battlespace, the CJTF takes away the enemy's ability to act.

- **Conduct Decisive Operations**. The CJTF has an integrated combat capability to conduct decisive operations. It has maneuver capabilities that can be used to seize/secure key terrain or facilities as well as to dislocate and defeat enemy forces.

- **Sustain and Transition the Force**. The CJTF possesses a streamlined logistical structure. When combined with a common operational picture, as well as supply and maintenance efficient combat organizations and platforms, this structure enables the CJTF to conduct operations at a higher tempo than that of its opponents.

3.3 *Organizational Tasks*

Listed below are the capabilities of the CJTF categorized in accordance with the Universal Joint Task List (UJTL) within the US and the Joint Essential Tasks (JETs)[10] within the UK. In each area, the CJTF must have C2 systems capable of accepting additional assets and fully integrating them into specific subsets of CJTF operations.

3.3.1 *Develop Intelligence*

The CJTF intelligence systems tie directly into US and UK national collectors and producers. Connectivity to joint and national intelligence collectors provides wide-area surveillance for the entire CJTF area of operations. The tie in to coalition, joint, and national intelligence producers provides a detailed intelligence picture of the area from an enemy and environmental perspective.

MI brigade assets provide the CJTF with intelligence data within the area of operations. The intelligence analysts of the brigade can fuse and correlate this data with the joint and national intelligence producers to produce a detailed, focused, high-resolution, all-source picture of the CJTF battlefield. This picture can be used for targeting for direct and indirect fire systems,

[10] In the UK a series of Joint Essential Tasks (JETs) have been developed, these are similar to the US UJTLs in that they cover the Strategic, Operational and Tactical levels. They are effectively a hierarchical list of tasks that are not logically linked, as is the AAM.

positioning and directing maneuver elements and for enemy and environmental situation awareness.

The CJTF intelligence system has the necessary communication and automation support linkages to receive digitized reports from all intelligence disciplines (SIGINT, HUMINT, and IMINT) as well as weather and terrain data.

CJTF combat, combat support, and CSS commanders, down to company/battery/troop level, share the same enemy and environmental situation awareness information provided by the CJTF intelligence system.

The CJTF commander can rapidly mass and focus his reconnaissance and surveillance capabilities to maximize the CJTF's direct and indirect fire weapons.

3.3.2 *Deploy/Conduct Maneuver*

The CJTF has the capability to maneuver forces in a low to high intensity conflict environment. It emphasizes the use of offensive and defensive IO to enable dominant maneuver and precision strike with joint assets while minimizing collateral damage. The CJTF capitalizes on the unique capabilities of each of its maneuver components.

The CJTF employs centrally directed reconnaissance and intelligence collection to gather operationally significant information while subordinate elements focus on tactical reconnaissance. Its information gathering capabilities prevent defeat in detail on a contiguous or non-contiguous battlefield. Reconnaissance synchronization cells reside within each major subordinate component of the CJTF, to include CSS and aviation assets. The reconnaissance and surveillance capability resident within the CJTF constitutes its principal means to develop the situation as well as know when, where, and how to attack targets by using distributed operations.

The CJTF uses synchronized strike tactics to conduct the combined arms fight. The combined arms fight delivers fires using IO, close air support (CAS), indirect fire assets, and direct fire systems to dislocate and defeat enemy systems. The CJTF's capability to conduct shaping operations in support of the combined arms fight will rely on the coordinated fires of CAS and indirect fire systems, supported by C2 attack. The CJTF employs effects as the system of choice, and then uses its infantry and armor to seize, secure or clear key terrain and/or facilities.

The CJTF's rotary-wing aviation assets are capable of conducting attack, reconnaissance, and target designation for precision strikes with smart munitions. Reconnaissance and surveillance technologies that enhance the ability of helicopters to detect, acquire, classify, and disseminate information about threat forces will provide near real time input to the common operational picture. The CJTF will have the capability to conduct air assault and air movement operations in all types of terrain.

The CJTF has the capability to utilize joint intratheater transportation assets to conduct operational level maneuver.

3.3.3 *Employ Firepower*

The CJTF is capable, at multiple levels of command, of directing synchronized organic, coalition, and joint fires. Situational awareness resident within the CJTF, when coupled with deliberate planning and its capability to employ organic weapons and to leverage supporting precision weapons, allows the CJTF to dislocate or defeat an adversary by accurately engaging numerous critical targets within a compressed time window.

Assigned and attached indirect fire systems can dominate the battlespace up to 30 kilometers from the location of the firing unit. Selected high payoff targets can be attacked to a range of 300 kilometers. The CJTF is capable of using supporting assets to conduct offensive IO to destroy and disrupt enemy C2.

3.3.4 *Protect the Force*

The CJTF organic short-range air defense (SHORAD) capability is primarily focused on the protection of critical assets from air attack. High value and less mobile support assets, such the CJTF command post and CSS facility, receive priority for active protection.

Organic military police assets conduct route reconnaissance, traffic regulation, refugee control, and law enforcement liaison with Host Nation police organizations. The CJTF military police relieve the CJTF commander from using combat power to secure C2 sites, CSS elements, and ground supply routes. When dictated by METT-T, the JTF commander will attach additional MP assets to the CJTF for the purpose of securing enemy prisoners of war (EPWs).

The CJTF continually denies the threat any opportunity to gain an advantage in situational awareness. It uses organic assets, such as deception, operational security, indirect fires, counter-reconnaissance operations conducted by maneuver assets, and SHORAD in order to ensure complementary active and passive countermeasures are effectively employed against threat information gathering systems. The CJTF will leverage joint and reach-back capabilities to gain and maintain superior situational awareness.

Threats may employ automated attack technologies against CJTF C4I, situational awareness, and reach-back communications networks. Organic C2 Protect (C2P) capabilities are embedded within the CJTF C4I system to militate against the successful employment of low-technology information warfare by the threat.

3.3.5 *Exercise Command and Control*

CJTF headquarters C2 systems are equipped with long-range, secure voice and digital communications that can be directly linked to joint C2 systems. The CJTF's robust C2 capabilities have direct links to joint assets at multiple levels of command. Attached communications support elements are responsible for CJTF information transfer networks, spectrum planning, external communications coordination (host nation, joint, and multinational),

as well as related C2P requirements. Commanders have the ability to operate with their forces and are not tied to command posts.

The CJTF C2 structure is focused on continuous execution of assigned missions. It can plan and rehearse on the move. Forward Area Air Defense (FAAD) Command, Control, Communications and Intelligence (C3I) capability provides situational awareness of the air/missile defense picture. Organic SHORAD systems are vertically and horizontally integrated with direct sensor-to-shooter linkages. The CJTF is also directly linked to the US Joint Air and Missile Defense, Ballistic Missile Defense, Command, Control, Communications, Computers and Intelligence (AMD BMC4I) network.

The CJTF possesses the capability to integrate the headquarters of attached/OPCON subordinate elements equipped with traditional communications systems by employing compatible communications linkages or liaison teams, as required.

The CJTF maximizes use of non-line-of-sight communications technologies.

3.3.6 *Perform Combat Service Support*

Logistic support is a national responsibility for each coalition member, except as altered by mutual agreement. However, the CJTF headquarters will closely monitor all aspects of CSS operations. It will have the capability to exercise in-transit visibility of all classes of supply and the oversight of the execution of all types of field services. This seamless sharing of data across national lines enhances the CJTF's ability to anticipate shortfalls and shift assets, even across national lines, when necessary.

As US CSS operations automate, they are increasingly characterized by centralization. UK CSS will logically use this same technique for optimizing the potential CSS automation.

Streamlined organization maintains sustainability while increasing deployability. CSS systems support rapid projection of the CJTF as well as continuous operations in theater.

During sustained combat operations, the CJTF is resupplied via a combination of air and ground L of Cs. It can be entirely resupplied via aerial L of C, during operations of limited duration. Superior situational awareness allows the CJTF commander to anticipate operational pauses in which CSS assets are deliberately surged forward to provide needed CSS within a compressed time window. At the conclusion of an operation, or during an operational pause, CJTF maneuver assets will be repositioned to facilitate future rapid CSS operations. CSS elements use a common operational picture of the battlefield to better anticipate requirements and maximize battlefield distribution. This enables CSS unit's access to robust communications networks that will enable them to review and pass information from support elements to theater or CONUS/UK providers.

The tempo of CSS operations is tethered to the battle rhythm of the CJTF. The CJTF CSS assets are positioned based on METT-TC, where they can best support combat operations. Maintenance operations within the battlespace, other than operator level repairs, are limited in duration and

scope. Vehicle operators are trained and certified to perform system-specific crew plus (+) level of maintenance for high-rate, low mean-time-to-repair (MTTR) failures on ground systems.

The CJTF medical capabilities are focused on stabilization of wounds/injuries and early evacuation of casualties. Self-aid/buddy-aid is essential to the early treatment of injuries. Combat lifesavers are maximized at all levels.

Personnel Service Support (PSS) is provided through split-based operations maximizing information technologies exported from the sustaining base to the CJTF. On site PSS from the supporting Personnel Services Detachment, in the form of a Forward Area Support Team (FAST) will deploy with the initial force to offer immediate assistance with casualty operations and strength reporting. Additional PSS assets from reinforcing forces and/or the follow-on force package will augment the CJTF, as required.

The CJTF CSS structure includes an organic contracting capability to procure facilities, local equipment and services, as well as a support team that can provide the entire range of financial services to CJTF personnel.

Additional Unit Ministry Team (UMT) (Chaplains Department) and Judge Advocate General (JAG) (Army Legal Services in the UK) support is also provided via reach-back linkages.

4. **Modeling and Information Thread Analysis**

Whilst the US members of the team developed potential operational concepts and organizations, members of the UK half of the team examined the AAM to see if the model supported coalition operations and to identify any issues that each of the activities might have regarding interoperability with a US Corps. In addition the UK team were also engaged in reverse engineering the US Force XXI Divisional C2 model developed in IDEF0. This latter work was started in the UK but due to the numerous questions that arose from terminology used in the model it was not until both teams were gathered for a four-day workshop at Fort Leavenworth that the UK team could begin to understand all aspects of the model.

4.1 ***Examination of the AAM***

An early review of the UK AAM highlighted the problem that although the joint aspects of warfare had been considered and linking activities from the Army to the Joint C2 environment had been developed there were no linking activities into multinational operational planning. This led to a refinement of the AAM and the inclusion of multinational planning activities in the Level 1 model and the specific development of a model at Level 3 - Exchange of Advice in support of Joint/Multinational Operations, which iss shown in the diagram at Figure 4 below. This model has subsequently been developed to Level 4. The Root Definition for this model was:

‘A system to achieve a coordinated plan at the joint national and multi-national level for the employment of land capability through the exchange of advice between national organizations.’

And the description as follows:

‘The establishment and maintenance of a Multinational Planning Group to review National Priorities, establish and maintain relationship with National Strategic Planning Authorities, taking account of the appropriate constraints (including legal, cultural considerations and technical developments) and changes to the battlespace in order to provide advice to National Strategic Planning Authorities on Multinational Operations in terms of the emerging campaign plan, the capability of coalition forces, the command relationships between Multinational partners and the status of all missions relevant to the campaign.

NATO is a permanent alliance with structures and relationships between allies already established; Coalitions are ad hoc where this is not the case. Nevertheless there is a need to reduce the incidence of conflicting interests generated from parallel chains of command (national and multi-national).’

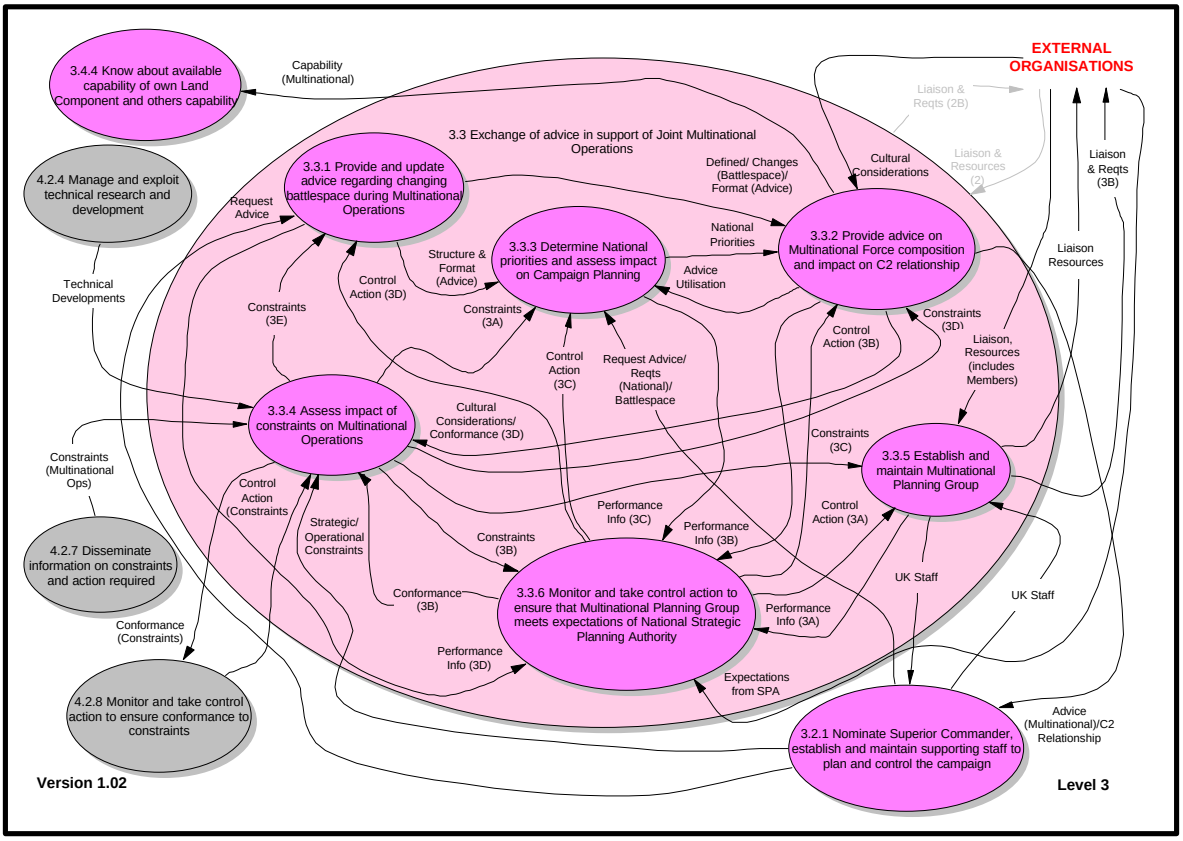

Figure 4 – UK Army Activity Model ‘Exchange of Advice in support of Joint/Multinational Operations’

Key activities were:

- Provision and update of advice regarding changing battlespace during multinational operations.
- The ability to ensure that national priorities are taken into account during campaign planning.

- The provision of advice on multinational force composition and impact on the C2 relationship.
- The establishment and maintenance of a multinational planning group. Composition being dependent on the number of alliance or coalition partners involved in the operation.
- The assessment of constraints on multinational operations these include technical and cultural constraints.
- The ability to ensure that any multinational planning group meets the expectations of national strategic planning authorities.

At the operational and tactical level the AAM was considered to capture the key activities for C2, sustaining the Land Component, execution of Land Component tasks and the inclusion of a model, which specifically looked at coordination with others during operations, ensured that the need to establish effective liaison with either alliance or coalition partners in multinational operations was covered. The 'Coordinate with others during operations' model is at Figure 5.

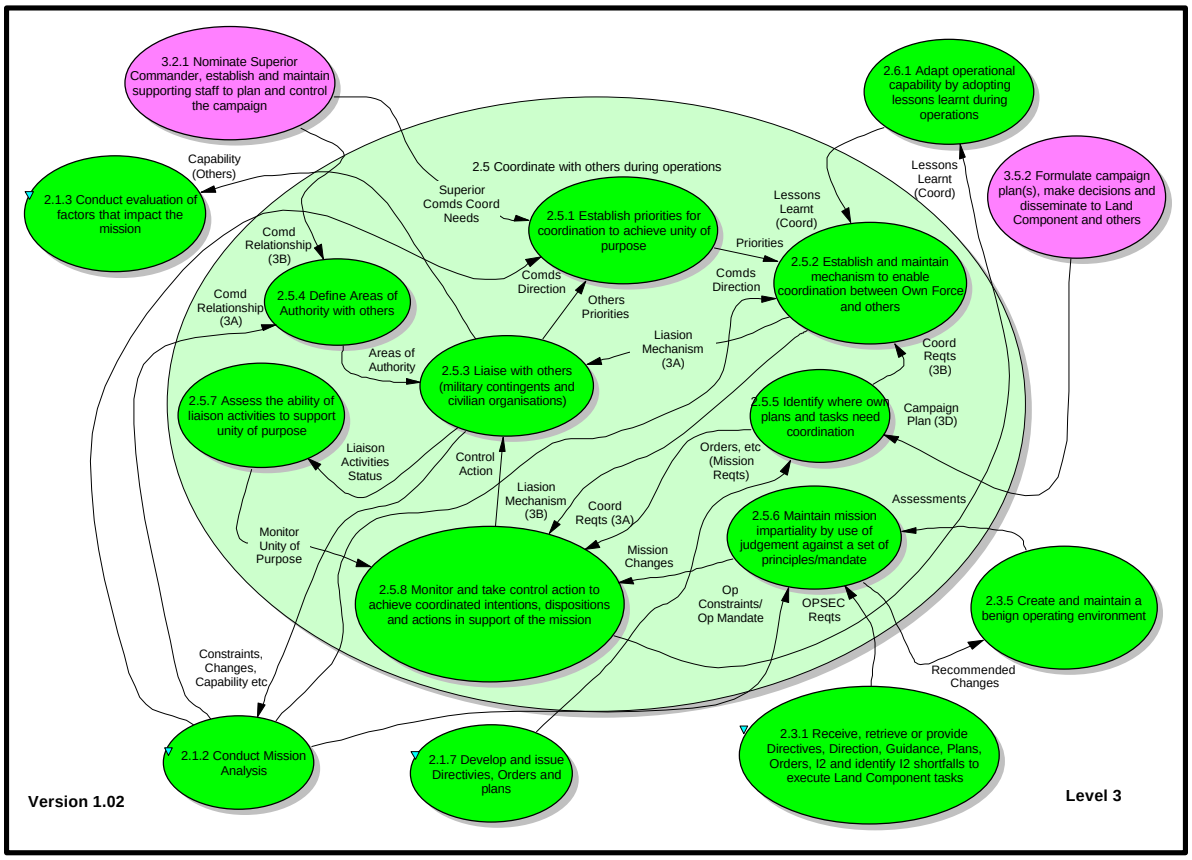

Figure 5 – AAM Model 'Coordinate with others during operations'

The Root Definition for this model is:

'A system in which own forces establish and maintain unity of purpose with allies, OGDs and civil agencies by exchanging information through liaison, coordinating planning, decision-making and action in order to support the mission objectives.'

This model when first developed catered for all levels from strategic to tactical, the development of a specific multinational planning model in Figure 4 meant that this model was applicable at the operational and tactical level as had been the initial intention when developed for the UK's initial OA models of High Intensity Conflict and Peace Support Operations. What clearly stands out from this model is the need to ensure that effective mechanisms for coordination are in place.

4.2 *Issues from Analysis of the AAM*

The AAM was then examined in three areas; C2 (in particular Coordination), Targeting (specifically the ability to conduct Deep Ops) and Sustainment to identify any issues that might arise from the conduct of coalition operations. They were subjective and based on the experience of the team whose experiences were from the infantry, artillery and logistics. A list was produced and summarized in the diagram at Figure 6.

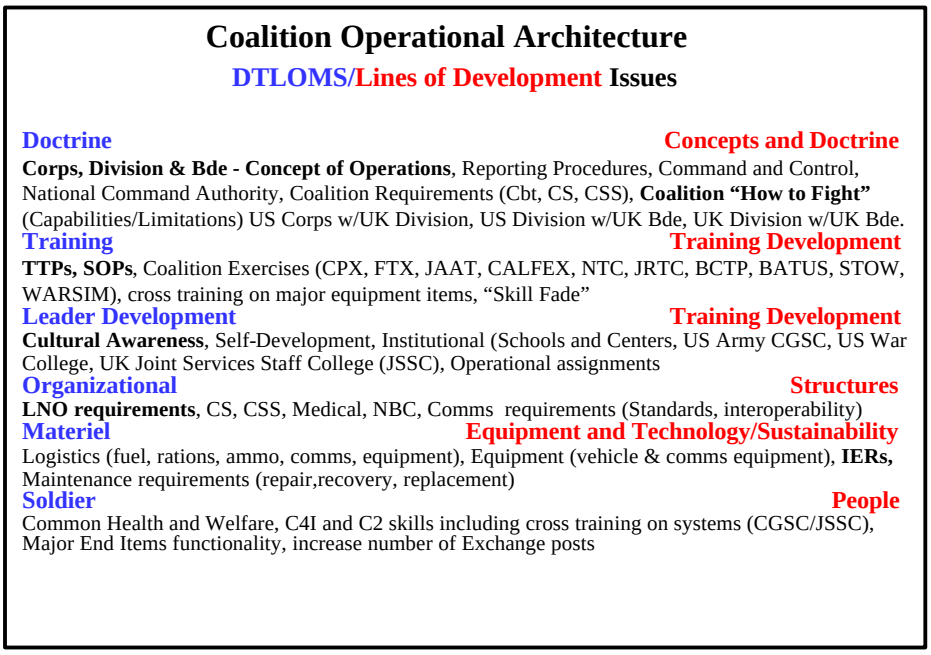

Figure 6 – Example of Issues from Analysis of AAM

4.3 *Identification of Information Flows between US Corps and UK Division*

In order to identify the information flows between a US Corps and a UK Division and to confirm that the processes carried out by the US, and UK Land forces are compatible and ensure that the UK Army business model (AAM) has the processes and information flows that support this type of operation, and that the interfaces with the US (Corps) IDEF business model have been identified it was necessary to reverse engineer the US Force XXI C2 Divisional model. In carrying out this task the following scenario was used:

- UK Division operating with a US Corps under the command of a (US) Land Component Commander (LCC in the context (JWP 010)) in a coalition operation. The 'Superior Commander' *external* in the AAM will be the (US) LCC.

- The UK will have a NCC as a part of the CJTF command team, providing advice to the CJTF, and liaising with UK strategic command (PJHQ[11]), and deployed UK Land forces (Land element), together with the Maritime and Air forces.
- There will probably be a liaison officer on the staff the (US) Land Component Commander.

To date due to resource constraints and other priorities this work is uncompleted, the method that we propose to follow is further work is approved is as follows:

- Identify information flows between US Corps and US Division IDEF0 models as a pointer to the information flows that would be required into, and out of, the UK Division.
- Examine the processes (in the AAM) to ensure that they are complete, and that all the (external) information flows are present. This will entail mapping organizations (UK Div) onto the AAM, informed by the US Div IDEF0 model. Work that is needed to support the UK's Digitization of the Battlespace (Land) programme.
- Modify the AAM as necessary.
- Note the issues arising from different ways of working, differences in terminology (using JETs/Capability mapping as an aid), and any changes in doctrine arising. Re-use analysis work from US visits.
- List the information product/information categories exchanged at any level in the UK Division command level (using QIP as a source of information).

Diagrammatically this method is shown at Figure 7 and is named after the consultant on the team who was grappling with how the UK team would conduct this area of work.

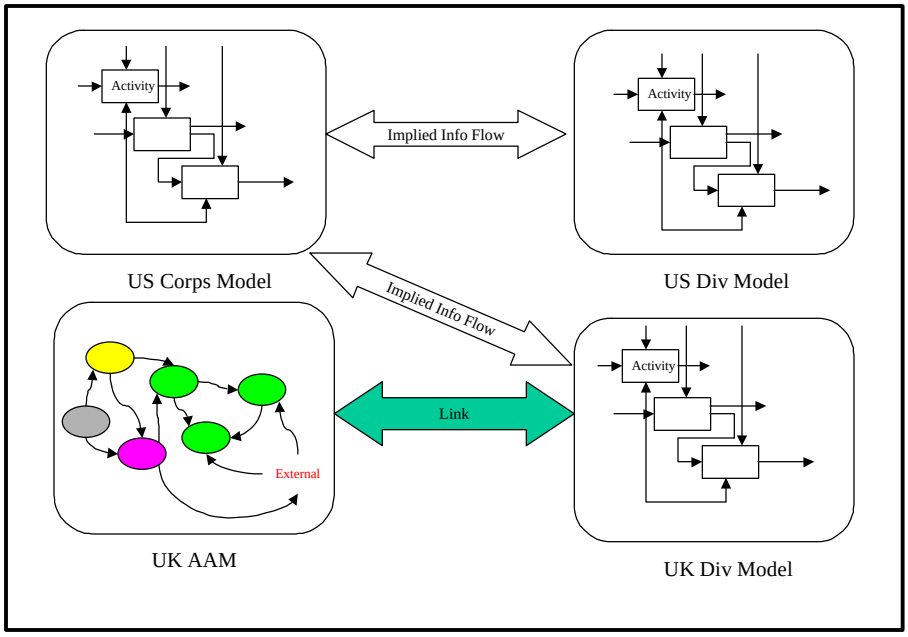

Figure 7 – The Strefford Methodology

[11] Permanent Joint Headquarters.

4.4 *Information Thread Analysis*

Although time did not permit detailed information thread analysis, the team were able to provide examples of what potentially could be achieved for inclusion in the US – UK Staff Talks. This aspect of the work relied heavily on the US members of the team who had had to carry out similar analysis previously. The two examples provided were for Deep Ops and Intelligence. In simplistic terms the information exchange requirement between a US Corps and a UK Div are shown at Figures 8 and 9. More complex IDEF0 diagrams were also provided to illustrate the complexity of the models and information and mission threads. These are shown at Figures 10 and 11. These examples were chosen specifically as the ability to conduct Deep Ops and Intel Ops between coalition forces is considered to be key activities. Further analysis is necessary to see if the systems used in the future will be able to be used seamlessly in the exchange of information.

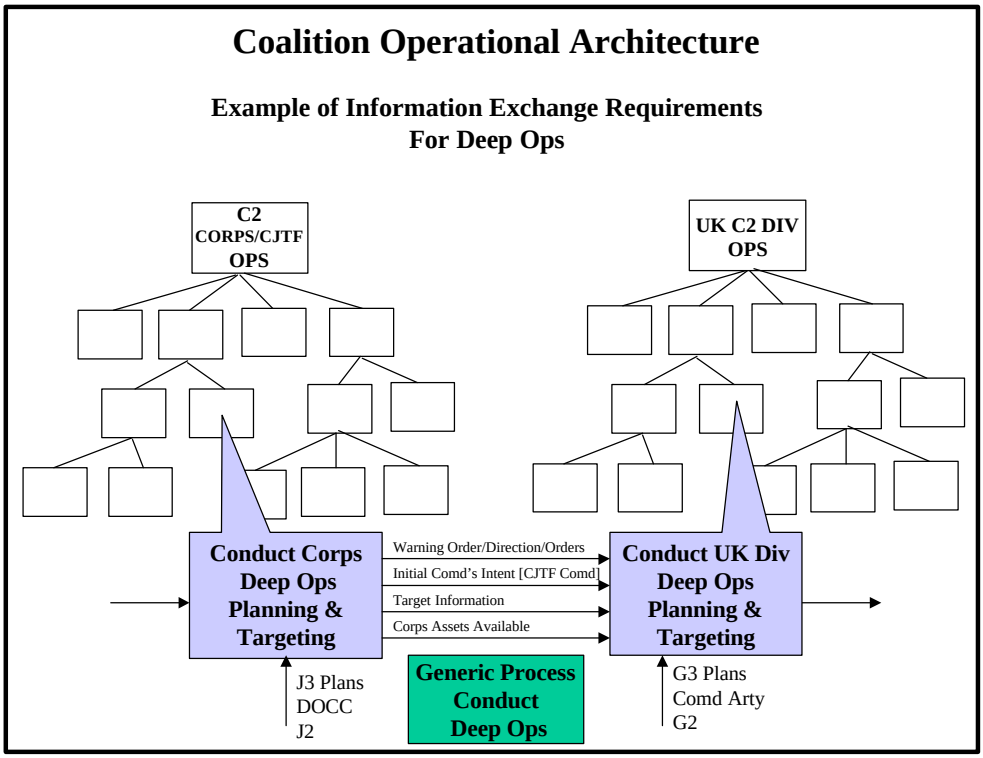

Figure 8 – Example of IER for Deep Ops

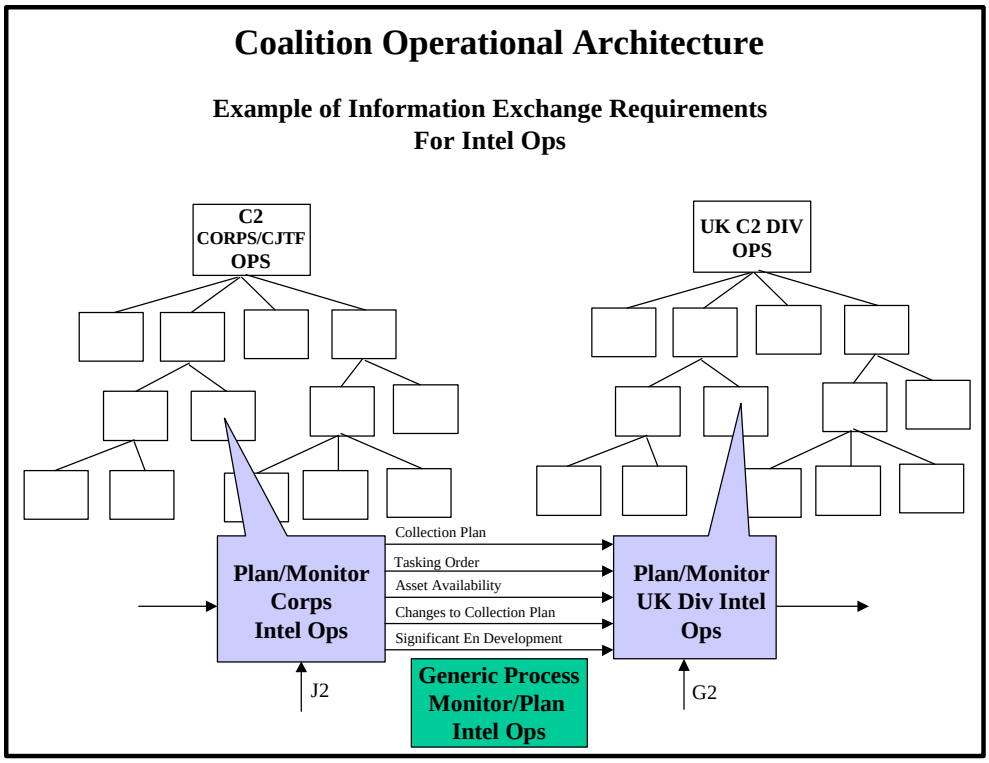

Figure 9 – Example of IER for Intel Ops

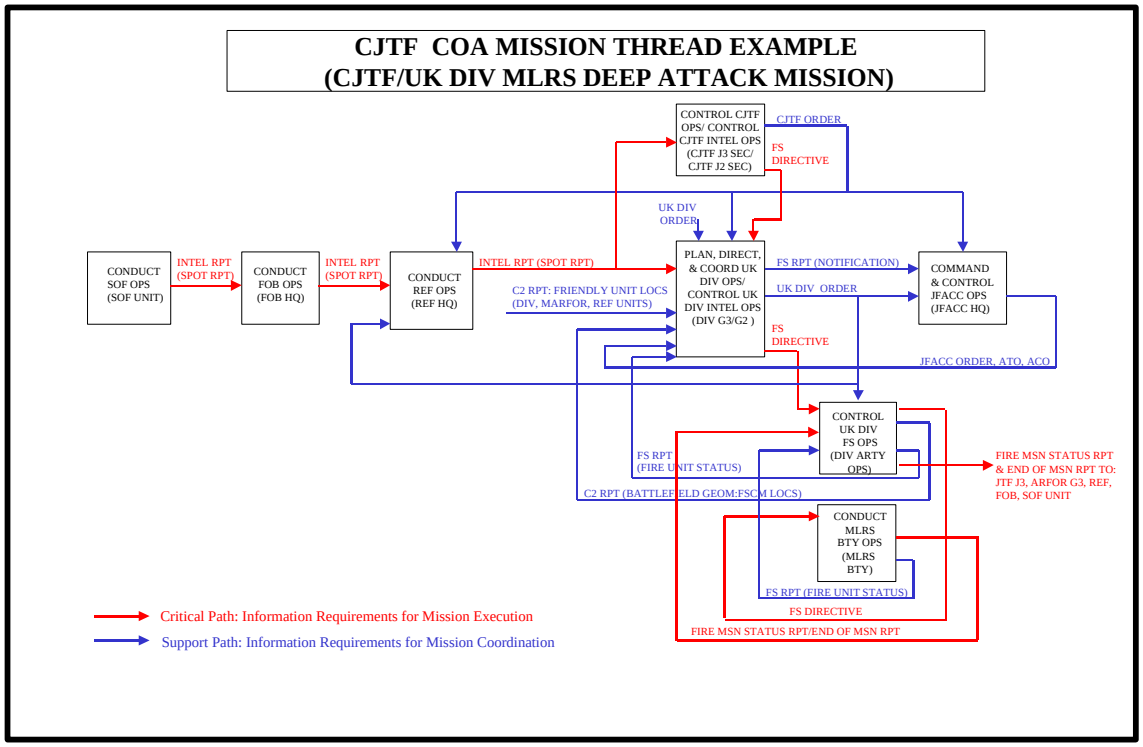

Figure 10 – CJTF COA Mission Thread Example for Deep Attack Mission

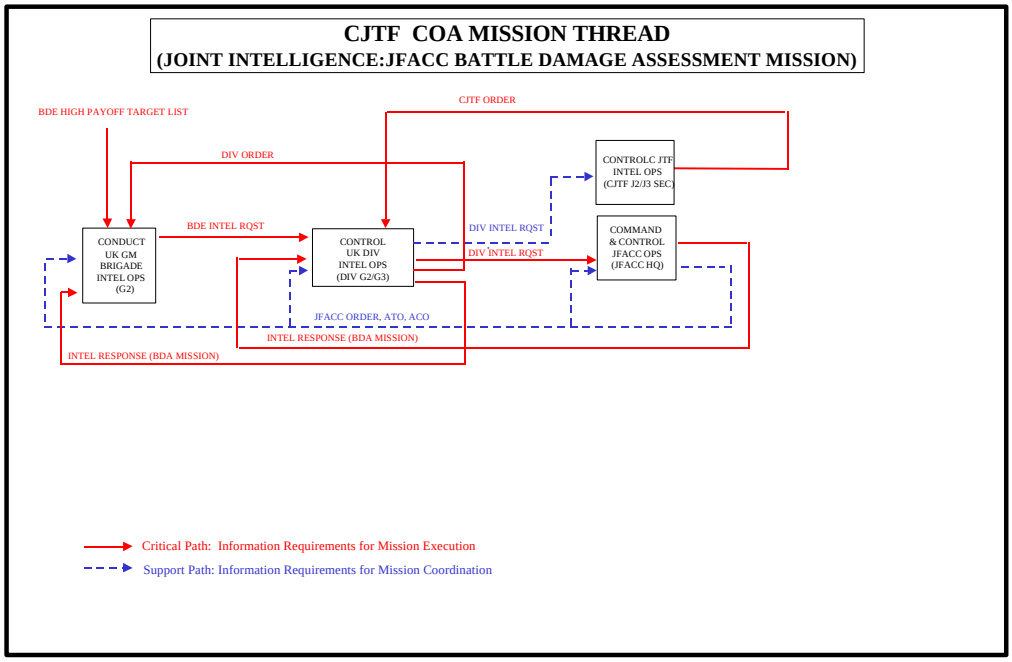

Figure 11 – CJTF COA Mission Thread: Joint Intel: JFACC Battle Damage Assessment Mission

5 Mapping to UJTL, AUTL and JETs

In the US there is a requirement to map (crosswalk) their activity models to UJTL and AUTL[12] examples of which are shown in the diagrams at Figure 12.

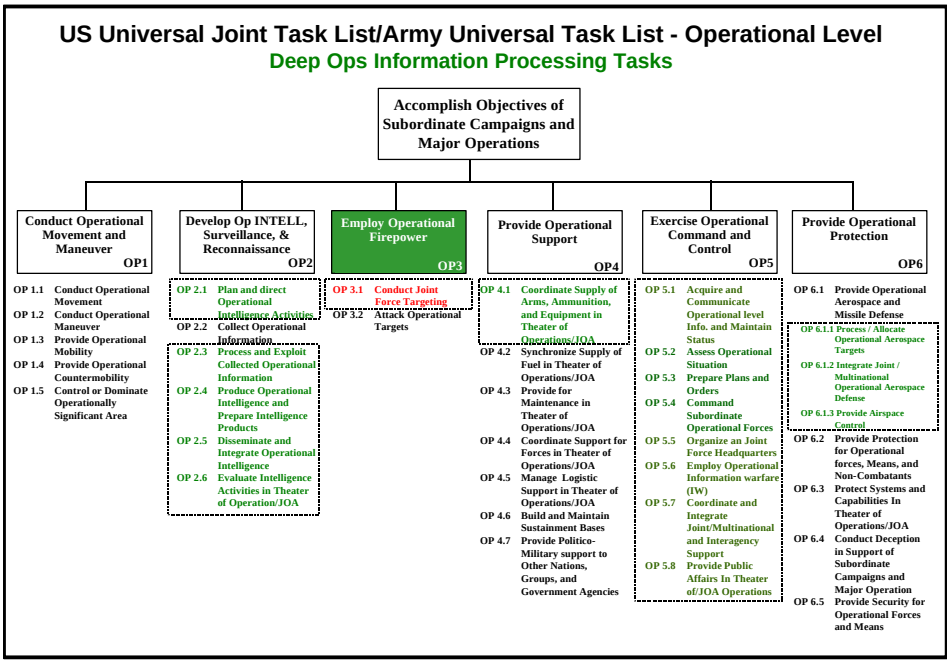

Figure 12 – UJTL /AUTL at the Operational Level with focus on Employ Operational Firepower

[12] AUTL is the Army Universal Task List. In the UK there is currently no equivalent list.

In the UK there is no requirement to do likewise but the AAM at Level 3 as been mapped to JETs (JETs are the equivalent set of tasks as laid down in the UJTL and where possible have been linked). An example of mapping to UJTL, AUTL and JETs is at Figure 13. However neither the UJTL, AUTL or JETs are process diagrams nor do they specify particular means for accomplishing an activity. For example, the collection of intelligence information can be accomplished by a variety of means, including satellites, aircraft, ground sensors, and infantry reconnaissance patrols. The task structure provides a means for examining missions and operations in terms of the same basic elements. In the US Army the more detailed process diagrams, which are used to examine information flow are IDEF0 diagrams. In the UK the use of the AAM and its associated AOA Mapping and Analysis Tool[13] (AMAT) performs a similar function To the untrained military eye both an IDEF0 and SSM diagram can be seen as a complex and less than user-friendly diagram. IDEF0 case-tools allow the production of hierarchical diagrams similar to those used in the production of the US UJTL and AUTL and the UK's JETs. The MooD case-tool used by the UK does not produce the same type of list.

What the UJTL, AUTL and JETs provide are a validation of IDEF0 or SSM models by ensuring that all tasks have been considered. The use of IDEF0 and SSM can also provide new tasks, which may have been omitted in the initial task list. As a result both sets of work provide potential contractors with a richer understanding of an Army's 'business'.

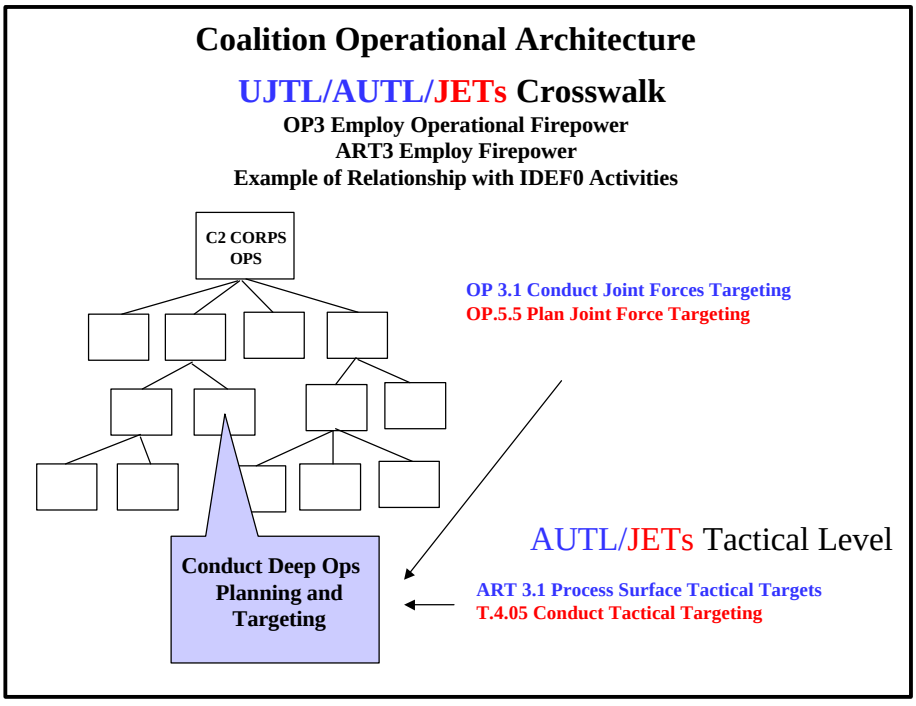

Figure 13 – Example of UJTL/AUTL and JETs Crosswalk

[13] The AMAT was previously known as the Real World Database, it allows the conceptual activities and the information categories identified as either an input or output from an activity within the AAM to be mapped to real world activities and information products. Sources and sinks can also be mapped, which in effect allows the UK to have one model but derive many instances of that model. In the US each IDEF0 model provides the same effect.

6. **Benefits of COA Work**

The benefits of developing a COA is that it will provide the tasks, functions, information exchange requirements and performance parameters through a disciplined process. The DTLOMS/LOD analysis will assist requirements determination for proponent/domain lead within DTLOMS/LOD. Finally the work leverages current Architecture efforts and products from both Army's and enables the effective expenditure of limited resources.

7. **Initial Thoughts on the Way Ahead**

In an effort to scope the effort and of developing a US/UK COA further meetings to finalize the Front End Analysis (FEA) are scheduled to take place. Some areas of consideration are:

- Identification of key players in the development of the COA
- Reuse of existing OA products
- Agreed Root definitions
- Tool suites, to include interoperability
- Development of Scoping statement
- Development of Operational concept diagrams
- Functional node trees/diagrams
- AUTL & UJTL crosswalk with JETs
- Operational overview
- Activity model.
- IER matrix
- COA analysis
- DTLOMS/LOD analysis
- Level of decomposition (Corps/Division staff and or Brigade staff)
- Resourcing – personnel, budget, time
- Coordination requirements
- Configuration management processes

Once the scoping effort for the COA is approved, each DTLOMS/LOD domain proponent, to include the Systems Architect's on both sides, can determine their level of effort required to implement the requirements.

A coalition exercise could assist in the analysis process and assist in determining the utility of the COA.

8. **Conclusion**

The continued development of US/UK COA is an essential element to ensure we are prepared to face and successfully execute future missions in a coalition environment. The functions and information requirements coupled with their performance parameters are key to the identification of future coalition requirements across the DTLOMS/LOD domains. This work may also inform other potential coalition partners.

9. Acknowledgements

- Dr Brian Wilson for his initial support in developing the Root Definitions and Level 1 CPTM for developing a COA and kind permission to reproduce the Overview of SSM at Appendix A.
- Dr Dick Whittington and staff at the Salamander Organisation Limited for their advice and support in the use of MooD.
- Major Mark Old for his support in developing COA issues.
- Staff from DESE Research Inc. (US), the Smith Group and Hi-Q Systems (UK) who supported the team in delivering the initial product in a short timeframe.

10. Appendices

A. An Overview of Soft Systems Methodology

11. References

[Wilson, 1992] Dr. Brian Wilson *Systems: Concepts, Methodologies and Applications*. Second Edition, John Wiley & Sons (ISBN 0-471-92716-3).

Appendix A

An Overview of Soft Systems Methodology
(A method for the analysis and definition of information requirements)

1. Introduction

Soft Systems Methodology (SSM) is, in reality, a set of methodologies. Each methodology is represented by a set of ideas (concepts) structured in such a way that their use is appropriate to the situation being analyzed. The use of SSM as a powerful problem-solving tool requires this flexibility. Each situation is unique and hence the methodology must be tailored to fit the situation and also the style of the analyst using it. Application of this kind is a sophisticated use of SSM and the analysts need to develop the ability to be so flexible as a result of considerable experience in a variety of situations. However a few standard methodologies have been developed as a result of the experience of practitioners such as Peter Checkland and Brian Wilson and these have general applicability for particular types of situation, such as Information Requirements Analysis, Role Exploration, Issue Resolution and Re-organisation. An overview of the Checkland Methodology is shown in the diagram at Figure 1.

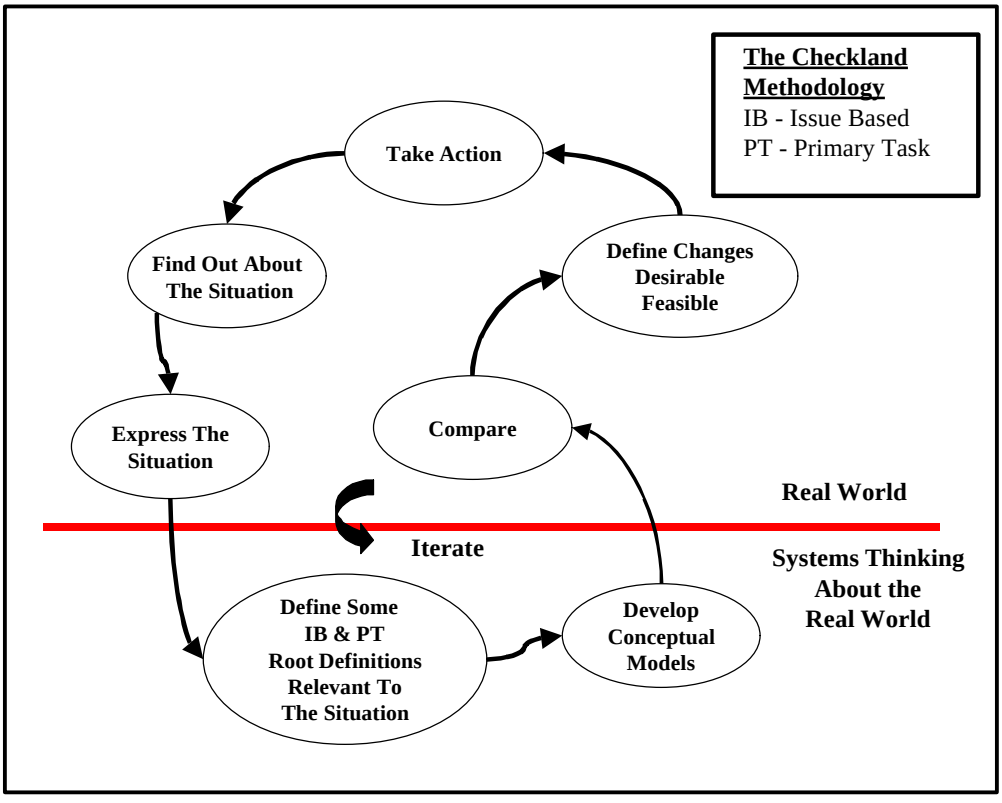

Figure 1. The Checkland Methodology

An overview of the information-oriented version is shown at Figure 2.

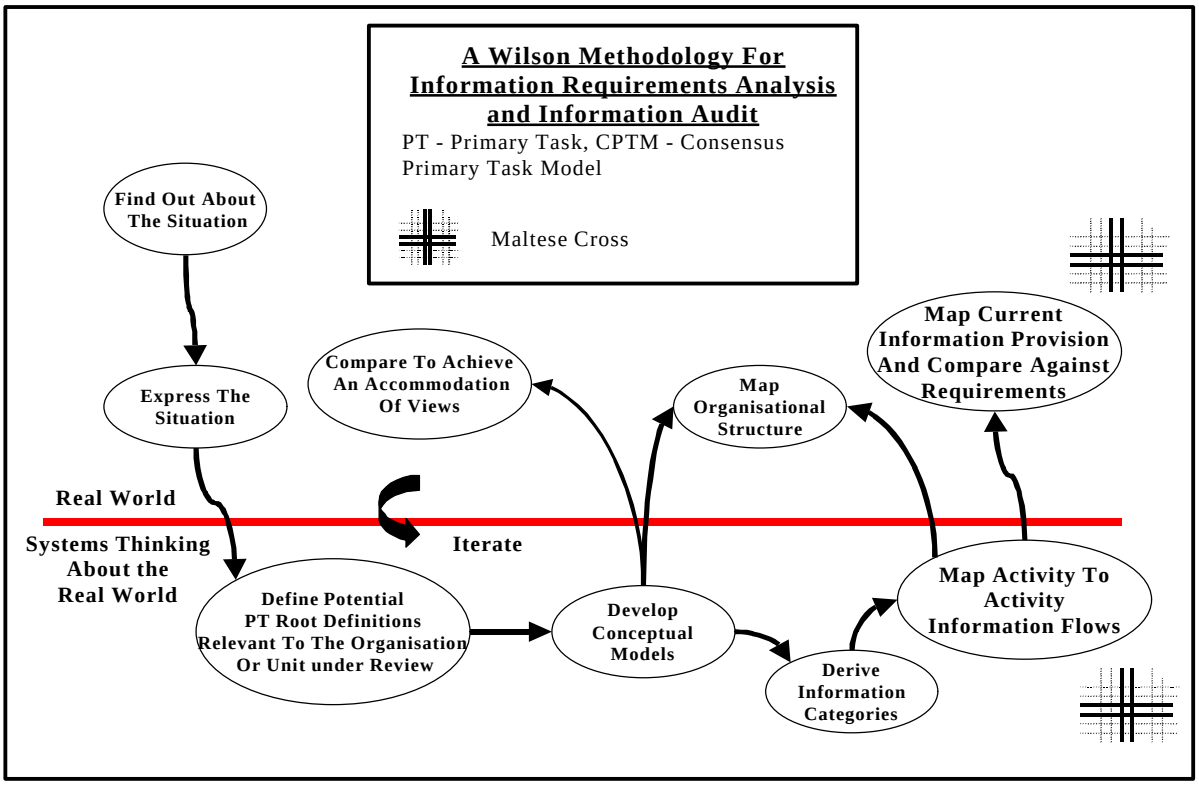

Figure 2. The Wilson Methodology

2. **Why is the Soft Systems Methodology useful?**

Approaches to systems development often fail to satisfy users' problems and requirements. Both the problems are not understood, or not identified, and therefore the information requirements which are supposed to address these problems are inappropriate, or at worst, not known. The secret to successful systems development is in understanding the users' situation, the problems associated with it and correctly identifying the information requirements. Often the problem is knowing what the problem is, and resolving conflicting views of problems and requirements between users. SSM addresses all these issues in the analysis and definition of information requirements.

Specifying information requirements relating to a business area is complicated. Information was confused with data and what are commonly referred to, as information systems are really data processing systems. If we take the definition of information to be:

"Data together with the meaning ascribed to the data"

Then we can develop a process of defining information requirements. This is based upon an analysis of how the data is used in supporting business processes. The SSM essentially supports the process of analysis of information requirements.

When we describe a set of business processes necessary for the achievement of a business objective further complications will arise; different individuals will interpret the objective in different ways. If, for example, we are developing information support for a prison, the set of business processes will vary depending on what we take the purpose of a prison to be.

We could take its purpose to be:

- To control the interactions of offenders and the community (a security perspective) or alternatively:
- To instill society's norms and values (a rehabilitation perspective)

Clearly the set of business processes required (and therefore the information support) would be vastly different in the two cases. In reality a prison is not any of these but is a mixture of these and other perspectives. However, different individuals will subscribe to different mixtures. This example, although extreme, represents the situation in all businesses though the differences may be subtler.

3. What does the Soft Systems Methodology provide?

- An explicit, organized and defensible way of reconciling different and/or conflicting perspectives
- The means to build a model of business processes appropriate to the users within the area of concern.

4. The Use of the Methodology

The methodology starts with the construction of a "rich picture' of the situation in which some concern has been expressed or in which some kind of information system is desirable. This identifies those organizational entities relevant to the investigation. It illustrates the inter-relationships of material, information and other resources, in addition to the features of the situation, which give rise to the concern or request. Features of the social situation such as inter-personal conflict, views of the situation etc. may have a significant impact on the conduct and outcome of the study and should be considered.

After this initial study the next stage in the method is to use the knowledge gained by the construction of the picture to derive a model representing the business processes, which accommodate the many perspectives and issues.

It is assumed that whatever the business is about individuals within it will play a meaningful role. Their roles and purposes may well be different because of the many perspectives described above but they will not be acting randomly or without purpose. Their function is therefore significant and relevant to the development of the system.

Carefully structured definitions known as Root Definitions are built which state the purpose of the system, for each of the different user perceptions identified. Purposeful activity models

(known as conceptual models) are developed next to represent this set of perspectives. These are built to form logical descriptions of what must be done to achieve the objective contained in each of the Root Definitions. These models then are not models of the situation but are modeling the perceptions of the situation.

A number of techniques are used within the methodology to assist in the analysis and definition of information requirements. The building of a rich picture, the organizational mapping (defining responsibilities for activities) and the 'Maltese Cross' (which allows comparison between the information systems required and those already in existence) are all valuable techniques.

5. **How are the products of SSM used?**

The models may be used in several ways:

- To compare against reality in order to make recommendations for procedural change which can be argued to be beneficial.
- To form a single model, reconciling the many perspectives, representing a 'taken-to-be' description of a business area.
- To compare this model against reality in order to re-define roles and organizational structures.
- To use this model as a source of information requirements to support the business area.

This last approach is particularly useful when developing an information strategy within an organisation or carrying out an audit of current information support for a business area. It is also recommended that it be used as an initial analysis for systems development projects using structured methods such as SSADM (Structured Systems Analysis and Design Methodology).

The rich picture provides the context of the situation in which such a development is taking place. The analysis identifies the organizational change, which is necessary to effectively incorporate the development. It also confirms, or otherwise, whether the proposed development is feasible, appropriate and if it should approved.

The SSM is a powerful, rigorous and prescriptive approach providing a sound foundation for proposed information systems development.