Exploiting Operational Architectures for Coalition Interoperability

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Abstract

After competing Phase 1 of work to develop 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 in the period March – September 1999, further discussions were held at TRADOC, Fort Monroe in July 2000 that lead to an agreement to progress the COA work as a proof of concept. Limited resources on both sides of the Atlantic meant that not all aspects of the work could be undertaken Phase 2 and this paper sets out how the work has progressed using both the model that was built by the UK using SSM and MooD, and the utilisation of the US Army models that had been built using IDEF0 and the requirement to align the work with the Universal Joint Task List (UJTLs) in the USA and Joint Essential Tasks (JETs) in the UK. It will examine how the UK approached the task agreed at Fort Monroe, and the difficulties in trying to bring together two methodologies, which although both were attempting to deliver a similar output, were in fact different in their construct and therefore incompatible.

Introduction

"By 2005, business process modelling will become a common business skill that delivers significant results (0.7 probability)." – Gartner October 2000

1. The United Kingdom (UK) began work on the development of its Army Operational Architecture (AOA) in December 1995. Its first version for release in May 1998 included three models, which were based on three views of the Army; a High Intensity Conflict view, a Peace Support Operations view and a Business view of delivering the Land component of military capability, and supporting concepts of use. The AOA was issued at as a website, which within the British Army at that time was itself an innovative way of exploiting the work. From January 1999 work began to bring the three views together and develop an information architecture – this model was initially called the Single Army Activity Model (SAAM) but has now been renamed

as the Army Activity Model (AAM). As currently described the AOA within the UK has four component parts:

- An Army Activity Model (AAM), which has been conceptually derived using the Soft Systems Methodology (SSM) and captured in the MooD case-tool.
- Information Architecture.
- A mapping of Applications to assess coherence.
- Comparison with real-world organizations.

The relationship between each of the component parts is shown diagrammatically at Figure 1.

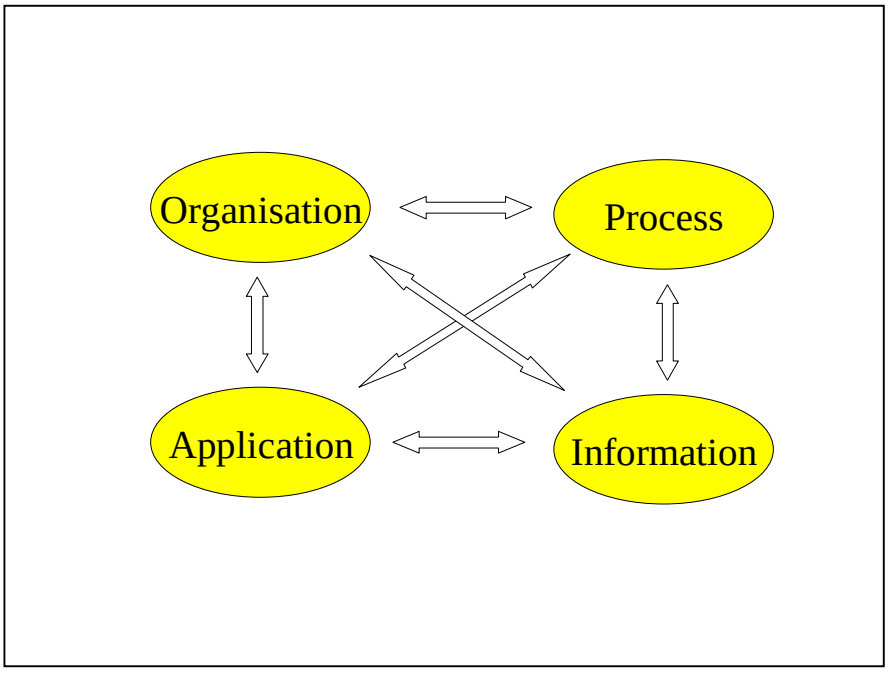


Figure 1 – Relationship between Component parts of the UK AOA

2. In parallel with work on the AAM in January 1999 discussions were held between staff from what was then the UK's Command Support Branch (now Command Development), 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 the US and UK AOA teams. This initial phase of work began in March 1999, and was in effect a scoping study and its findings were forwarded in a paper presented at the 2000 Command and Control Research and Technology Symposium. It had been anticipated that further work would follow the completion of the first phase but it was not until subsequent discussions at TRADOC, Fort Monroe in July 2000 that an agreement to progress the COA work as a proof of concept was sanctioned. At this stage resources were however limited on both sides of the Atlantic and it was agreed that not all aspects of the work would not take place in this second phase but the following would be completed by 31 Mar 01.

- US to build IDEF0 model for CJTF HQ less Information Exchange Requirements (IERs) Version 0.5. This did not include deployment, redeployment, and transition functions. There inclusion in future Coalition OA efforts to be based on identified requirements.US to produce Concept of Operations including Concept Diagram.
- UK to build IDEF0 model for UK Divisional HQ in order to produce an IER matrix using set of Common Information Requirements (CIRs) developed by US Army for their OA work in support of the Transformation process.
- Conduct initial analysis.
- Determine way ahead for future work and examine the feasibility of applying methodology to support other Coalition initiatives.

Perceived Benefits of COA

3. The perceived benefits of the COA were that:

- It would provide the tasks, functions, IERs and performance parameters through a disciplined process.
- DTLOMS/Lines of Development (LOD) analysis would assist requirements determination for proponent/domain lead within DTLOMS/LOD.It would leverage current AOA efforts and products from both the US and UK.
- It enabled the effective expenditure of limited resources.
- The work was seen as proof of concept for COA work with other potential coalition partners in order to determine interoperability requirements. The differences in systems, language, customs, methods of operations, etc. highlight the fact that coalition operations will be very complex and require detailed analysis and planning to ensure coalition partners can exchange required information, at the correct time and place on the battlefield. Establishing a solid foundation that defines a coalition approach to IERs is critical.

From a UK perspective the COA also provides a contextual framework for operational interoperability to inform and support other related initiatives, which due to rapid advancements in information technology and the development of unique systems by nations has meant that universal interoperability, even within NATO, of communication systems, software applications, and databases is not achievable currently. The COA is considered an approach that will support the development of capability, particularly applications, that will enable a UK formation to command or operate under command of a national or multinational formation.

Progress of Phase 2

4. The US Army OA staff with contract support completed their task in December 2000. The concept of operations did not differ too greatly from that developed in Phase 1, the concept diagram did change to reflect US thinking on its Transformation process and this is illustrated at Figure 2. No further work was carried out on the UK Division concept diagram, although staffs in DGD&D are reviewing future structures based on the processes that a Divisional Headquarters will need to carry out in future operations across the full spectrum of conflict.

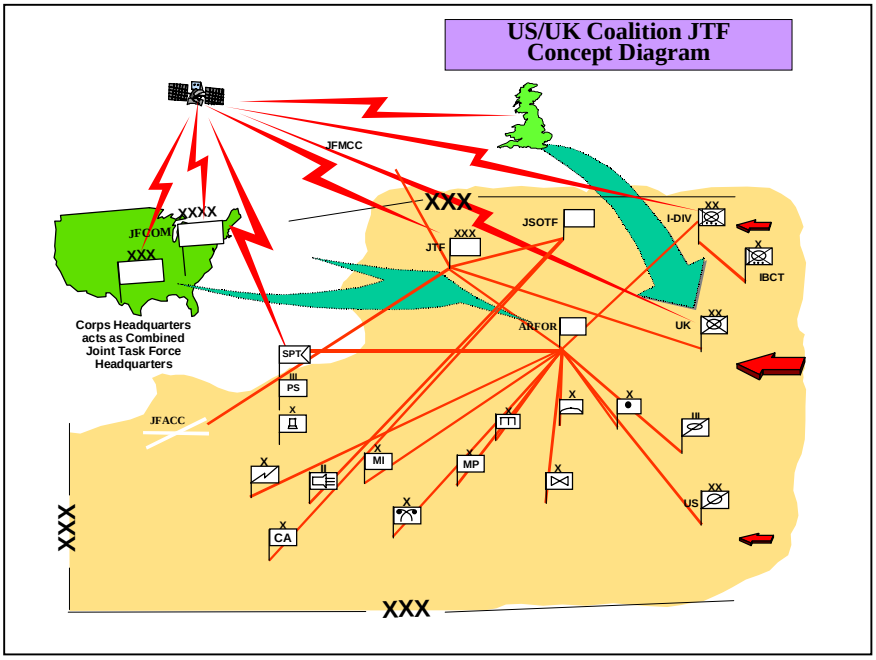


Figure 2 – Concept Diagram

6. The UK AOA staff initially set out to build an IDEF0 model for a UK Divisional HQ by reverse engineering a US Divisional HQ model that had been developed during the Force XXI initiative. Some of this had been started in Phase 1 but not completed. In addition since Phase 1 the US had developed what they were describing as a set of CIRs, and in order to have commonality across both models the UK agreed to use these in identifying the inputs and outputs in the leaf nodes in the IDEF0 model. This approach was described in Phase 1 as the Strefford Methodology and is illustrated in the diagram at Figure 3.

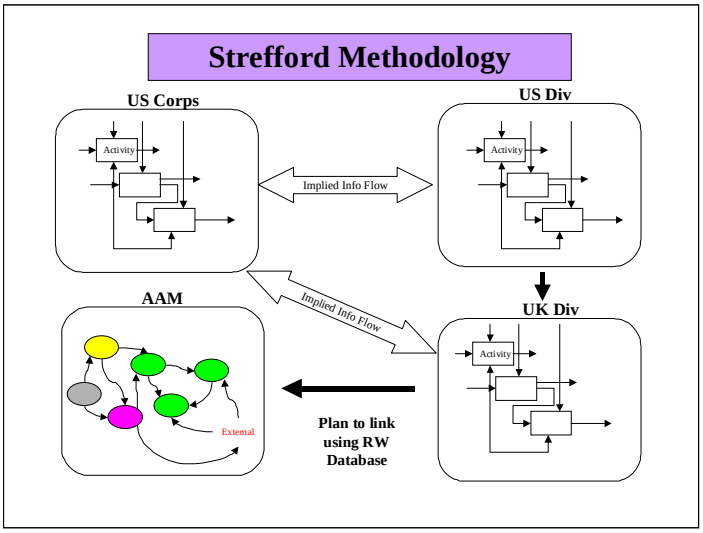


Figure 3 – The Strefford Methodology

7. There were two problems associated with the initial approach that had been determined by the UK in Phase 1:

- The incompatibility of two different methodologies IDEF0 and SSM as illustrated diagrammatically in Figure 4.
- The necessity to build a UK Div model in IDEF0 in order to produce the IER Matrix which was seen as a key benefit and then map activities to the UK's AAM meant that limited resources would have to complete an additional step to satisfy other UK requirements, which included the development of an information architecture and to determine the coherence of applications in meeting both business and battlespace processes.

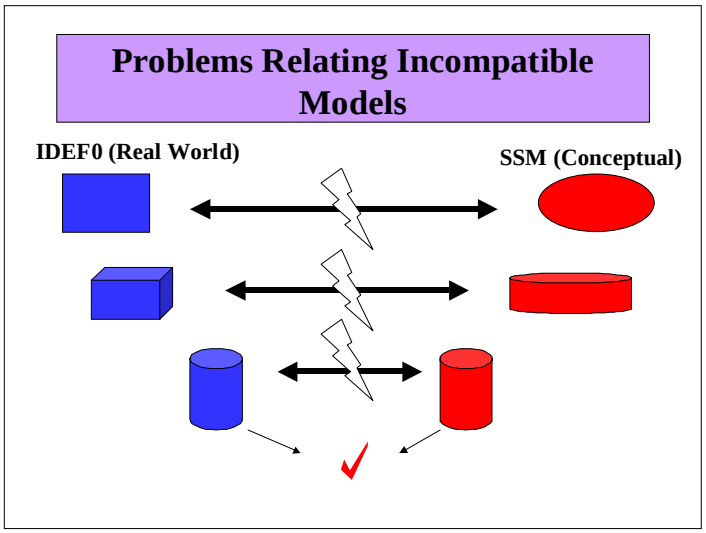
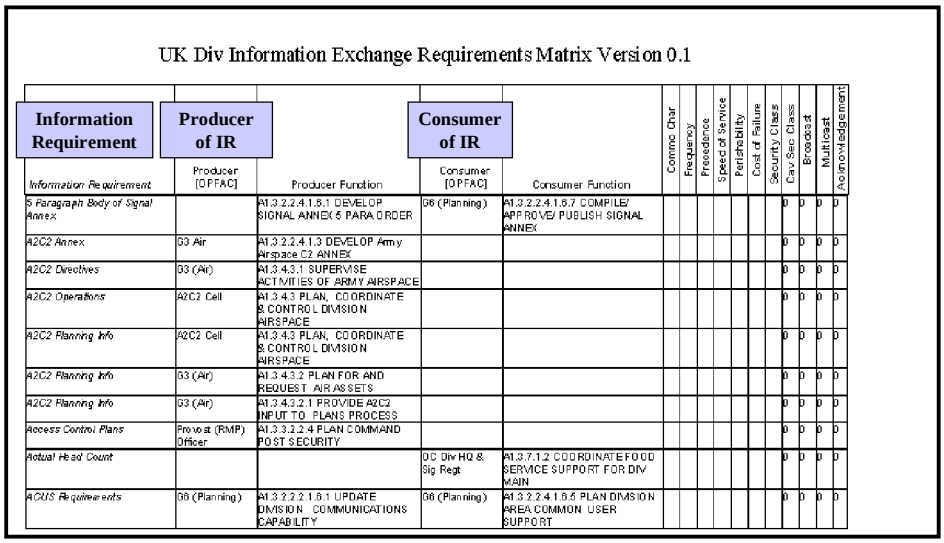


Figure 4 – Problems Relating Incompatible Models

Methodology Adopted

8. One of the key outputs from the COA was the delivery of an IER matrix as illustrated in Figure 5. In the US AOA work this is not derived from the IDEF0 case-tool but from an AOA Analysis Tool developed by DESE Inc, who are the contractors supporting the AOA effort at Fort Leavenworth. The software extracts information from three of the reports that the case-tool provides. The US has also refined their approach to modeling in that they now concentrate on populating the leaf nodes in the IDEF0 models with inputs and outputs and the mechanisms that carry out the processes. Off page referencing is used to identify sources and sinks of information and increasingly they have adopted a coherent set of CIRs which have been derived as a result of an analysis of what USMTF, VMF, or FM 101-5-2 report or message is most applicable to the information requirement. This does not mean that this message or report format completely satisfies all the elements of information that are described in the definition, only that this message or report appears to satisfy (from the name and definition of the message or report) the information requirement. From a UK perspective these CIRs are similar to information products, which themselves are the wrappers for information categories. To ensure understanding the UK agreed to use the same CIR set in order to identify those IRs that would be input to a UK Divisional by a US Corps, which may also be a CJTF HQ or CJLCC.



UK Div Information Exchange Requirements Matrix Version 0.1

Information Requirement	Producer of IR		Consumer of IR		Comms Char	Frequency	Precedence	Speed of Service	Perishability	Cost of Failure	Security Class	Cav/Sec Class	Broadcast	Multicast	Ack/non-ledgement
Information Requirement	Producer [DFFAC]	Producer Function	Consumer [DFFAC]	Consumer Function											
5 Paragraph Body of Signal Annex		A1.3.2.2.4.1.6.1 DEVELOP SIGNAL ANNEX 5 PARA ORDER	G6 (Planning)	A1.3.2.2.4.1.6.7 COMPILE/ APPROVE/ PUBLISH SIGNAL ANNEX								0	0	0	0
A2C2 Annex	G3 Air	A1.3.2.2.4.1.3 DEVELOP Army Airspace C2 ANNEX										0	0	0	0
A2C2 Directives	G3 (Air)	A1.3.4.3.1 SUPERVISE ACTIVITIES OF ARMY AIRSPACE										0	0	0	0
A2C2 Operations	A2C2 Cell	A1.3.4.3 PLAN, COORDINATE & CONTROL DIVISION AIRSPACE										0	0	0	0
A2C2 Planning Info	A2C2 Cell	A1.3.4.3 PLAN, COORDINATE & CONTROL DIVISION AIRSPACE										0	0	0	0
A2C2 Planning Info	G3 (Air)	A1.3.4.3.2 PLAN FOR AND REQUEST AIR ASSETS										0	0	0	0
A2C2 Planning Info	G3 (Air)	A1.3.4.3.2.1 PROVIDE A2C2 INPUT TO PLANS PROCESS										0	0	0	0
Access Control Plans	Provost (RMP) Officer	A1.3.3.2.4 PLAN COMMAND POST SECURITY										0	0	0	0
Actual Head Count			DC Div HQ & Sig Regt	A1.3.7.1.2 COORDINATE FOOD SERVICE SUPPORT FOR DIV MAIN								0	0	0	0
ACCS Requirements	G6 (Planning)	A1.3.2.2.2.1.6.1 UPDATE DIVISION COMMUNICATIONS CAPABILITY	G6 (Planning)	A1.3.2.2.4.1.6.5 PLAN DIVISION AREA COMMON USER SUPPORT								0	0	0	0

Figure 5 – IER Matrix

9. The UK approach was to utilize the IDEF0 model developed for the US Division and analyse each of the activities in the model to determine whether the activity was conducted in a UK Division or not, and by whom within the Divisional Headquarters. The methodology applied to provide the agreed output of an IER Matrix that supported the aims of the work to establish a coalition baseline of command and control (C2) functions and IERs is illustrated in Figure 6.

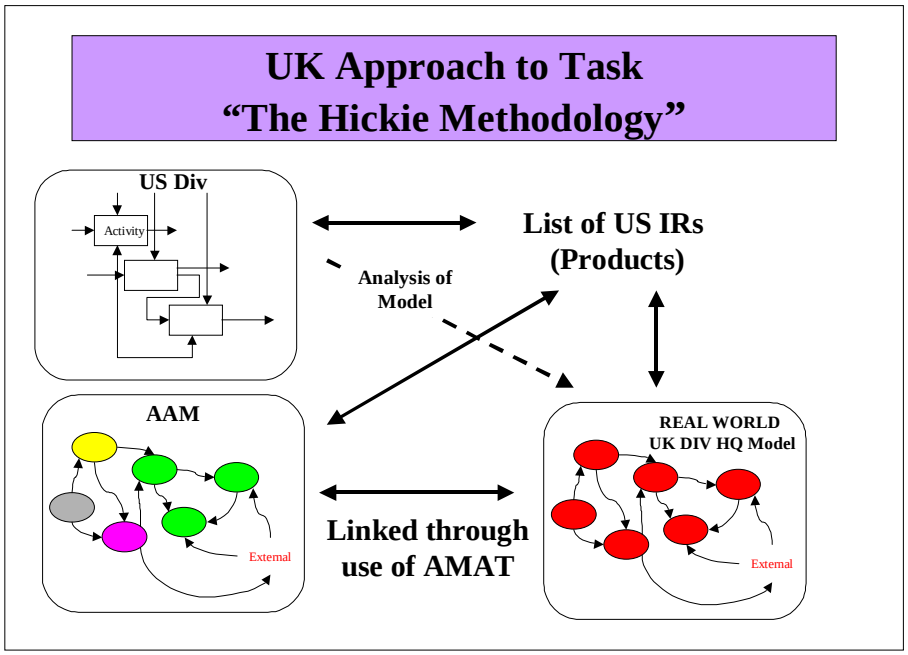


Figure 6 – The Hickie Methodology

The matrix itself will be output from an extension to the MooD application, which was specifically developed for the UK by Salamander, a consultancy company that provides support for MooD users. This tool is known as the AMAT (AOA Mapping and Analysis Tool) and is used to support real world mapping of organizations and applications to conceptual processes

and information categories. The AMAT is still under development and a number of changes will be made to further support the AOA in the UK as a result of testing and evaluation with the COA work. It is also under evaluation in Australia and our US partners in the COA work are proposing to utilise its construct in aspects of US AOA work.

Capturing Data in AMAT

10. To utilise the AMAT it is necessary to populate the AAM and its constituent parts. Processes, ORBAT elements and Applications are held within the MooD repository as a 'Business Process' Custom fields are annotated to identify Command and Staff Functional Areas (CSFA). A CSFA is assigned to a process, ORBAT element and Application. Information Categories and Information Products are captured as 'Business Objects'. When opening the AMAT application there are a number of steps. Step 1 is to log on the AMM repository; Step 2 is to open an ORBAT element. Use of this element will identify all those conceptual processes associated with the CSFA associated with an ORBAT element. The 'Real World Activity' (RWA) associated with the ORBAT element can then is mapped to the conceptual process. Information products that are either an input or are an output of a RWA can be added and the source or sink of that information annotated by associating a mechanism (application or manual system) to the information. This process is illustrated in Figure 7.

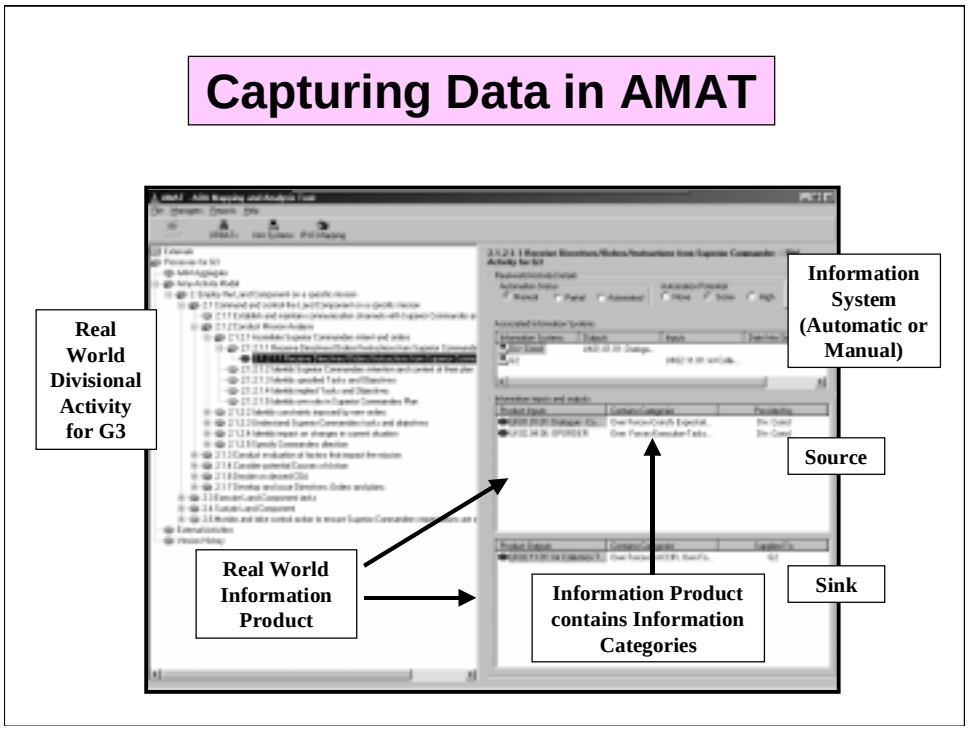


Figure 7 – Capturing Data in AMAT

Information Category – Information Product Mapping

11. In addition Information Categories can be associated with Information Products and this is simplified by the ability to drag and drop objects in the IC/IP Mapping Window, which is illustrated at Figure 8.

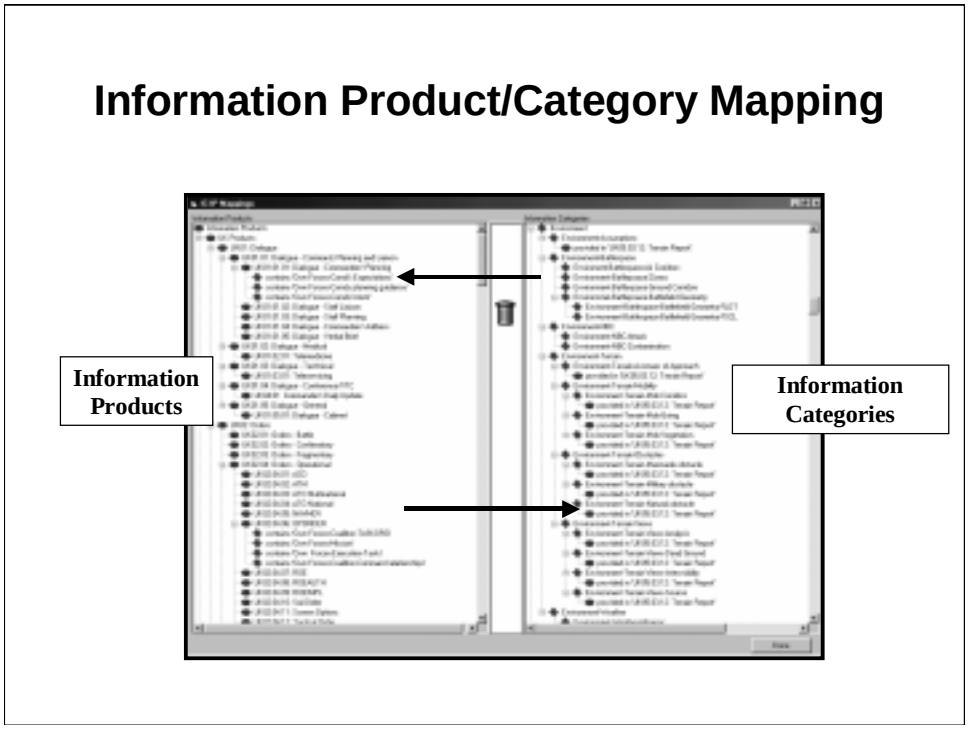


Figure 8 – IC/IP Mapping Window

Once the relevant data is captured for the UK Division the IER Matrix can be fully populated to enable capability analysis to be conducted.

Future Work

Development of the Information Architecture

12. The further development of the associated information architecture in the AAM is a key area of work, which is essential to determining application coherence and interoperability requirements for application development. Some scoping work has been carried out in the area of 'Targeting', which has enabled the team to identify; the characteristics of information (attributes, services and states), the relationship between Information Categories, the events that make information change over time. The most elementary activity can lead to the identification of 'operational services'. Developing an 'Operational Service Architecture' is the key logical enabler for Application Integration. It shows what information needs to be accessed in support of the activity and exactly which attributes need to be created, read, updated or deleted. Overall this work will support:

- The understanding of information needs
- Information Management
- Mapping 'information' to data structures
- Defining requirements for applications
- Application Integration (using 'Operational Services')
- The enablement of inter-operability***UJTL/JETs***

13. In the US the AOA work is cross-referenced to the US UJTLs/AUTLs. This has not been a requirement within the UK but the equivalent Task List in the UK is the Joint Essential Tasks (JETs – currently Version 5.0) and the AAM at Level 3 was initially mapped to Version 4.0 of the JETs. In addition the Land equivalent to the AUTLs is the Mission Essential Task List (Land) (METL(L), which are currently being developed. As a starting point the AAM is being utilised. It will be necessary to align the AAM with the latest version of the JETs to ensure that in the conceptual model all tasks can be identified and the appropriate association made. What as been of value in developing the AAM is the Measures of Performance (MoP) that are associated with each JET and this has been used to inform work developing MoPs for a RWA. The capture of MoPs is illustrated in Figure 10.

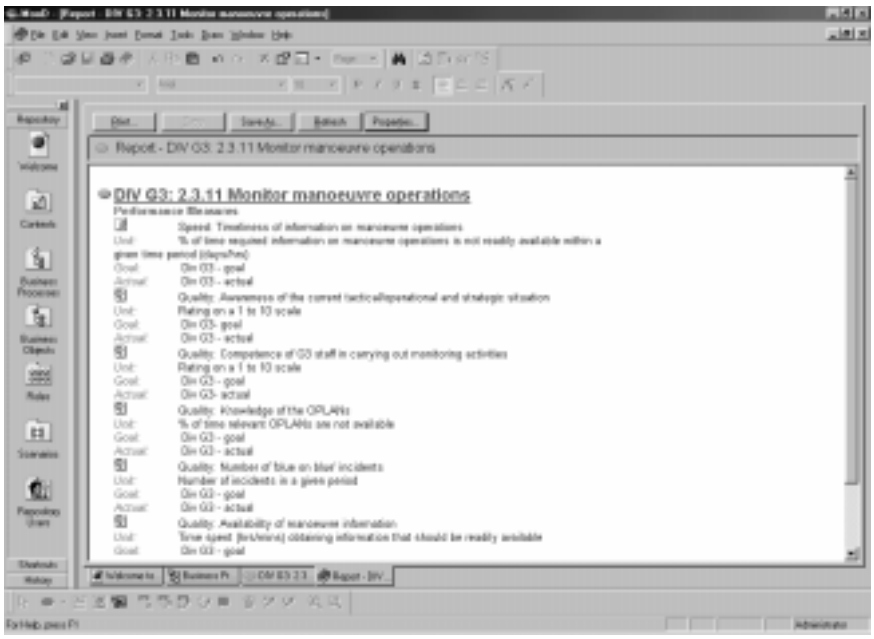


Figure 10 – MoP for a RWA

Capability Analysis

14. This is the next essential step having identified those key interface processes in coalition operations between formation headquarters. Having identified the key processes and identified the IERs it will be necessary to ascertain how these processes will be carried out and the capability currently available to support the process and future capability. This work needs to be done with the formation headquarters and DTLOMS/LOD proponents.

COA Phase 3

15. Whether further work is carried out between the US and UK on the COA will be dependent on the value both sides perceive from doing further work. This will depend also on national priorities given that resources are finite and both nations are actively pursuing Digitization goals for their respective force elements. There is a requirement to assess the capability required to enable both the UK and US to interoperate in a coalition operation in the

context of the work that was initiated in April 1999. For this to be achieved the US need to complete work on either its CJTF model to include IRs or its ARFOR model in order to identify those IERs applicable to assigned forces in a coalition operation. The AAM and AMAT may prove to be the cost effective way of achieving this by mapping those models created by the US.

Conclusion

16. There are still a number of issues that need to be addressed in coalition operations and it is recommended that this work should be taken forward to support interoperability in coalition operations of the future using operational architectures as the mechanism for detailed organisational and information needs analysis in order to determine through DTLOMS/LOD proponents the capability needed to address interoperability needs. However one of the continuing issues that all process modellers have to contend with is that in delivering results through process modelling -operational architectures – they are going to labelled as:

- Too much work
- Too long-winded
- Too expensive
- Too theoretical
- Too high-risk

To some extent there is truth in this statement, the UK approach is however considered a cost effective solution and by utilising the conceptual framework provided by the AAM derived using SSM, its supporting information architecture and organisational and application mapping, the labels given to this type of work can be lessened. In conclusion it is highly likely that; future systems will not be aligned to business and battlespace needs, systems will be inflexible, systems will cost too much, the training needs of users will not be completely met, procedures, processes and organizations will be dated, data received will be no good or too old, vital information to support the commanders decision making process will not be available and finally systems will be slow and less responsive unless operational architecture work is undertaken.

"Enterprises should view modelling as a key to linking strategy and goals to implementation, and should use analysis techniques as primary mechanisms for understanding and optimising processes." Source Garter October