Using IDEF3 To Capture The Air Campaign Planning Process

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1 Overview

To date the knowledge elicitation and modelling for the air campaign planning process has been carried out in the context of the CommonKADS method. However the intention is to take a multiple method approach to the modelling. The information presented in the current CommonKADS models, which are largely descriptive, will be remodelled using IDEF3, providing a more rigorous representation. This report provides some examples of this type of model and brings to light aspects of the models which are not represented in the current KADS models. It is expected that the two techniques will be complementary, highlighting areas for further elicitation, resulting in a more complete model of the air campaign planning process.

2 Modelling with IDEF3 - Process Capture Method

A model of the Air Campaign Planning process is being built up using the IDEF3 process capture method.
IDEF3 is part of the IDEF family of methods development funded by the US Air Force to provide modelling support for systems engineering and enterprise integration. The IDEF family includes modelling methods such as IDEF0 and IDEF1 (which are well-established process and data modelling methods), and descriptive methods such as IDEF3 and IDEF5, (an ontology description capture method).
IDEF0 is the earliest of the methods and is based on Structured Analysis and Design Technique. IDEF0 provides a method for analysis and communication of the functional perspective of a system, which involves constructing models of the decisions, actions and activities occurring within an organisation. Currently IDEF0 is the most widely used method from the IDEF family.
The IDEF3 method allows different user views of temporal precedence and causality relationships associated with enterprise processes to be captured. The information is presented in a series of diagrams and text, providing both a process-centred view of a system, via the Process Flow Network (PFN), and an object-centred view of a system via the Object State Transition Network (OSTN). This method can tolerate incomplete and inconsistent descriptions and is flexible enough to deal with the incremental nature of the information acquisition process.
IDEF3 can be used to produce data for many purposes. These include

provision of a systematic method for recording and analysing the results of information-gathering interviews; assessing the impact of various pieces of information on the operation of the organisation; support for systems design; support for the generation of functional modelling; knowledge acquisition for knowledge-based processes; and support for business process modelling.
The basic notation of the IDEF3 method consists of a series of square and oblong boxes, circles and arcs which link them. Attached to each icon is an elaboration form which contains a description of that icon, reference label etc, and details of related objects, facts and constraints acting upon it. The types of icons used in the following examples of PFNs are given below:

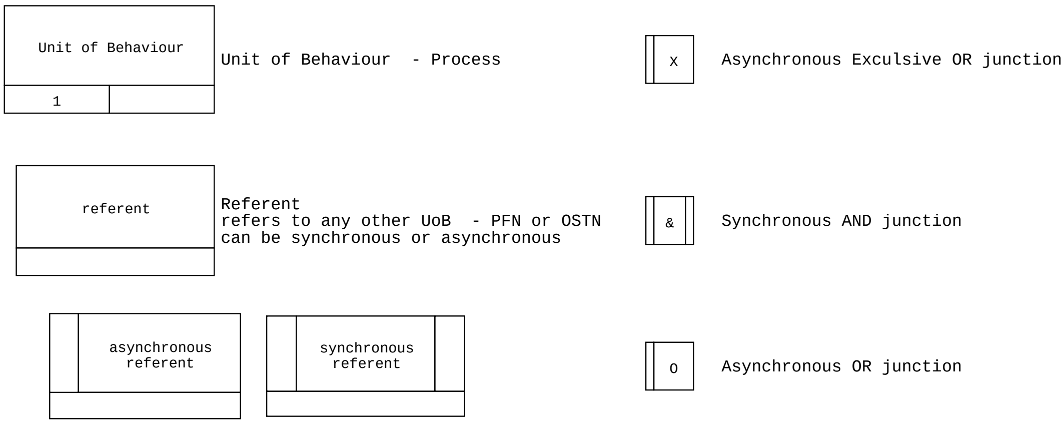

Figure 1: IDEF3 Process Flow Network Notation

A PFN displays a sequence of Units of Behaviour (UOB) which represent activities, actions, processes or operations. These are linked together by precedence arcs. Where the process flow diverges (fan-out) or converges (fan-in) junction boxes are used. Junctions are of the AND, OR or Exclusive OR type and can be synchronous or asynchronous. This notation may impose timing constraints on the process flow. For example, a synchronous fan-in junction indicates that the incoming processes must complete simultaneously before the next UOB can begin.
In addition to UOBs and junctions, PFNs can include referents, elaboration forms and UOB decompositions. Referents are used to indicate context-sensitive information and may refer to any other type of UOB such as an elaboration form, another PFN, an OSTN, an entirely different scenario, a

note, or act as a GO-TO within the PFN. In some cases referents may impose timing constraints on the process so there is the option to be synchronous or asynchronous as needed. An elaboration form holds specific information for each UOB such as the object used by it, constraints acting on it, facts about it and a description of it. Decompositions enable each step of the process to be broken down into more detailed process descriptions, allowing descriptions to be held at varying levels of abstraction. This is indicated on the diagrams by a shadow on the parent UOB box.

3 Air Campaign Planning - Process Flow Network

The intention is to re-model the information presented in the current KADS organisational and task models in IDEF3. The KADS models are presented in "Using CommonKADS to model the Air Campaign Planning process" by John Kingston - referred to as the KADS model document from here on.

The result of this will highlight the strengths and weaknesses of each modelling technique and illustrate how a multi-method approach can result in a more complete and robust final model. A brief discussion of the two modelling approaches is given in the next section.

These IDEF3 Process Flow Networks (PFN) are given to illustrate the type of diagrams which will be produced using this method. The models are incomplete. They have been constructed using a protoype IDEF3 tool on top of the HARDY hypertext diagramming tool.

Figure 2 shows the top level activities occuring within the air campaign planning process. These are shown as sequential as it is unclear at the present time which, if any, can be done in parallel. This diagram is very similar to Figure 3 ACP Process Perspective: Top Level in the KADS model document.

UOB 5 (plan air campaign) has been decomposed, as indicated by the shadow on the UOB box. The decomposition is shown in Figure 3. This shows the sequence of activities within the plan air campaign process. This is based upon Figure 4 ACP Process Perspective: Plan Air Campaign in the KADS document model. However some of the activities have been grouped together in UOB 5.1.8 (prepare for planning), with the more detailed breakdown shown in a decomposition.

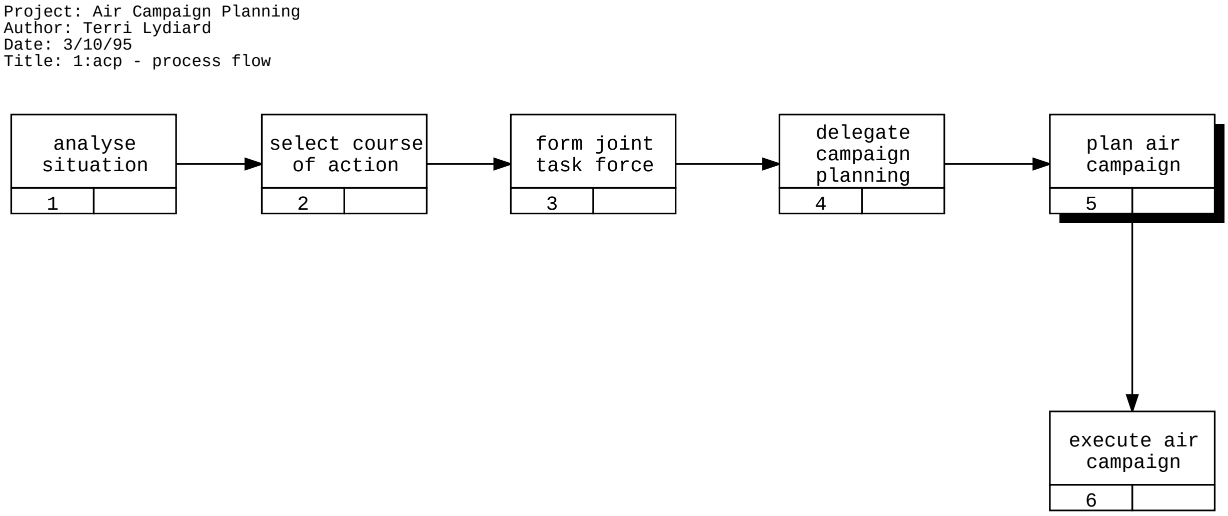

Figure 2: ACP Process Perspective: Top Level

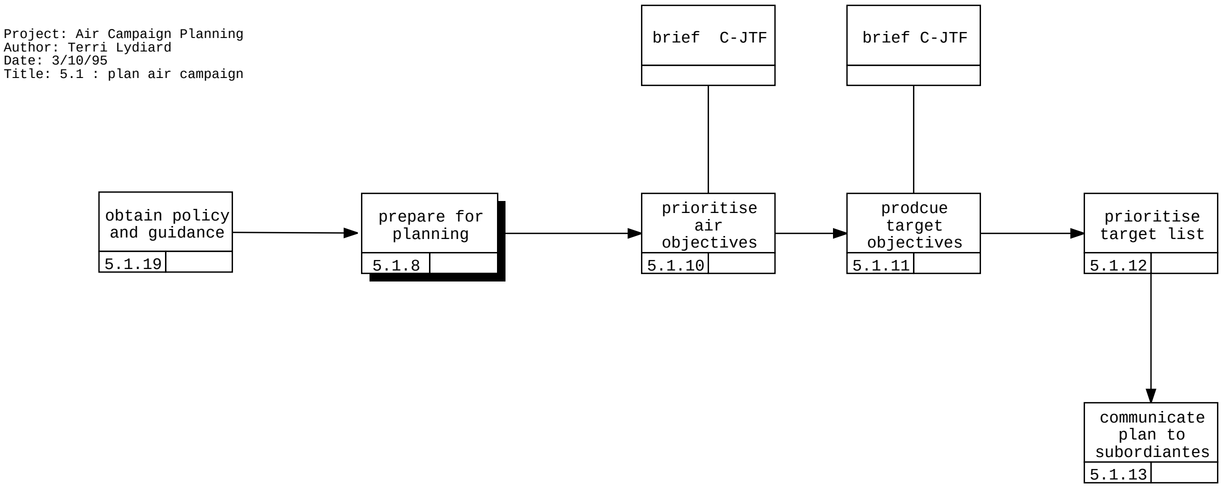

Figure 3: ACP Process Perspective: Plan Air Campaign

Referents are used to indicate that a briefing process occurs at two stages. These processes are important to note but are outside the scope of this model. The referents do not impose a time constraint on the main process, that is, although they must begin, they do not have to complete before the next process starts.

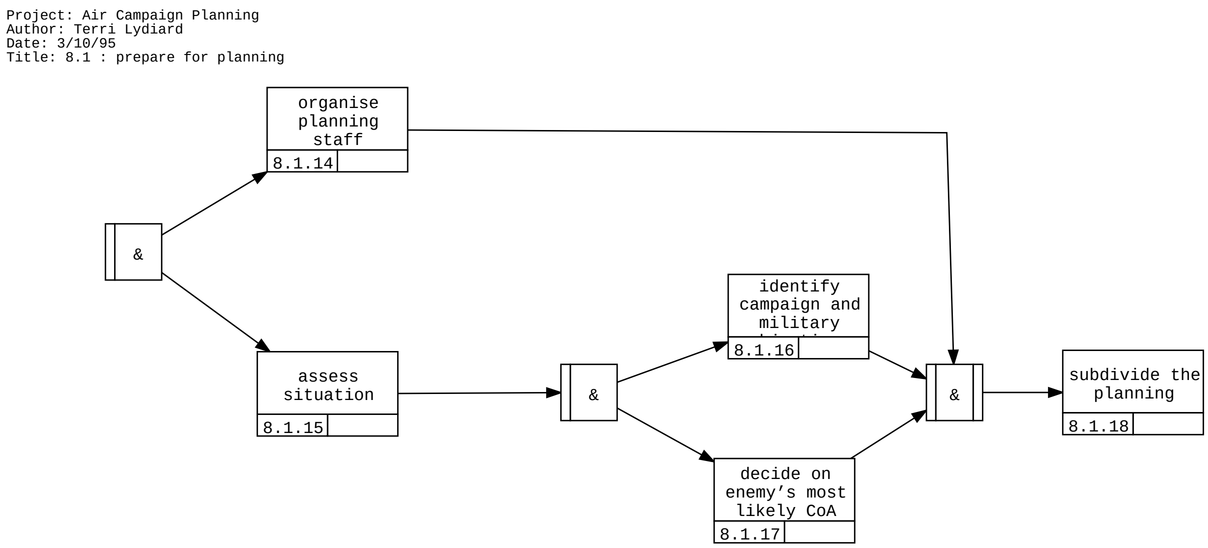

Figure 4: ACP Process Perspective: Prepare for Planning

The decomposition of UOB 5.1.8 (prepare for planning) is shown in Figure 4. This PFN shows some divergence in the process allowing two groups of activities to occur simultaneously, illustrated by the asynchronous fan-out AND junction. However the activities must all complete prior to the final activity at this level commencing. This is illustrated by the synchronous fan-in AND junction before UOB 8.1.18 (subdivide the planning process).

4 Benefits of the IDEF3 Modelling

There are a number of reasons why a multiple method approach should be taken to modelling the air campaign planning process. Firstly models derived by separate methods can be compared, ensuring consistency and correctness, helping to validate each other; secondly the models may be complementary to each other, illustrating different aspects of the same overall picture; and finally the models may provide different visualisations of the same problem for different purposes.

CommonKads provides a method framework for organisational, process and task modelling, specifying things which need modelling without specifying the method which should be used to do it. The models in the KADS model document are primarily descriptive, providing high-level, abstract models using an informal representation.

IDEF3 is a prescriptive method, providing a more rigorous representation with particular emphasis on temporal precedence and concurrency. IDEF3 models of the air campaign planning process will be complementary to the KADS models, acting as a refinement method reducing any ambiguity within the models, especially with respect to precedence and concurrency.

Remodelling the information presented in the KADS model document will have a number of effects on the knowledge acquisition process. The main effects will be:

1. using the IDEF3 technique will influence the way in which activites are clustered and the levels of decomposition. This will ensure some consistency in granularity by placing similar activities at the same level of decomposition. For example, showing all briefings of the Commander of the Joint Task Force (C-JTF) at the top level.

2. UOBs within an IDEF3 PFN are linked by precedence arcs, imposing a temporal constraint on the activities they represent. There is no indication within the KADS model of whether the activities carried out as part of the air campaign planning process must occur sequentially or whether they can occur in parallel.

3. the KADS model shows the main activities within the air campaign process. IDEF3 provides notation for showing alternatives to these activities, should they occur. No alternatives have been identified to date using the KADS modelling method.

4. in terms of visualisation, the KADS models have a tendency to be complicated. The straightforward uncluttered representation of the IDEF3 method will make these diagrams easy to understand and communicate.

The IDEF3 method brings to light some aspects of the model which are not represented in the current KADS models. It is expected that the two techniques will be complementary, highlighting areas for further elicitation, resulting in a more complete model of the air campaign planning process.