EXPLOITING UML TO MODEL MILITARY ORGANIZATION AND MILITARY BEHAVIOR

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Abstract

Unified Modelling Language is a set of graphical description techniques for specifying, visualizing, implementing and documenting object-oriented systems. The behaviour of military strategy and planning in a typical military organization is dynamic. A military organization has large number of entities (both distinct as well as similar) and the revalent relationships between them. There are also complex association between various objects. Also, the flow of critical and confidential information between wide varieties of objects makes modelling of a military organization more difficult. In this paper we present a study of modelling military organization and military behaviour in a generic manner, using the Unified Modelling Language (UML) as a knowledge representation technique. The class diagram that is provided by UML is well suited for representing military organizations whose structure is well-known, since military units and their interrelations can be represented as classes and interrelations between the classes. On the other hand, it is a much harder task to represent military organizations that are not wellknown or military behaviour because of the uncertainty associated with them. Different behaviours are triggered in different environments using different doctrines, and the outcomes of the behaviours are uncertain. Due to complexity, time constraints and war friction, causal relations between different factors, which play an important role in warfare, may be uncertain.

1. Introduction: Military organization and behaviour are described in military octrines. The first issue is how to model doctrines on a conceptual level and the second issue is how to implement these concepts in a concrete model. The connection between the conceptual level and a concrete model is also discussed in this paper. Modelling on the conceptual level has been performed by using textual and graphical documentation techniques associated with the Unified Modelling Language (UML), respectively. In this paper we will represent a doctrine class diagram in UML with focus on ground forces, and then discuss UML as a modelling technique. The UML model can be used for more general purposes or it can also be used to model the behaviour of a relatively small hostile force unit that acts in a certain environment. The importance of developing generic models in command and control (C2) is increasing due to issues of co-ordination, co-operation, training, decision support etc. When modeling warfare a plethora of factors has to be considered. In such complex problems the increasing need for classification of knowledge arises. We found it important to perform such a classification in a generic manner. The class models could then be reused with some modification and should be easy to update. Consequently, the modelling expert can concentrate on one part of the model at time. E. g., one generic model of a military organization and military behaviour can be reused for modelling different doctrines and for different purposes by using a well-known modelling technique. Consequently, we have performed a UML classification of doctrines in a generic manner. There are various benefits of modelling with UML.UML provides a host of features that makes it useful for modelling.

UML is Standardized, that is, UML is an accepted standard for modelling the behaviour of various real-world entities and the relationship(if any) between them. UML has a standardized set of symbols for representation of each and every element of an Object-Orient system. UML facilitates Graphical Representation of every element of an Object-Oriented System because it has a well-defined set of symbols for, thus the entire system can be modelled graphically. Besides UML improves understanding of the system improves as the entire system is represented graphically. The objects of the system, their behaviours, attributes and relationships are well depicted using UML. This also reduces Complexity in representation because an organization, like an army, is too complex to be represented in real world. UML, however, reduces this complexity as the entire system is represented graphically. The UML and the proposed Military Modelling model military systems and concepts very well. The Military Profile and modelling conventions, which guide the use of UML in the context of System Engineering and CBP, are presented in this paper. An important requirement expressed by military authorities about this profile was that it should be easy to be used by non-experts.

2. UML Inmilitarymodeling: In this work, we use two different modelling techniques. The first one is the Unified Modelling Language (UML). UML is a set of graphical description techniques for specifying, visualizing, implementing and documenting object-oriented systems. The aspect of the Unified Modelling Language (UML) that has been used in this paper is the class diagram. We have not performed sequence diagram representation in UML because of the tremendous complexity of the military operations considered here. The class diagram in UML provides graphical representation of object types, also called classes. The model describes relations between classes in a uniform way by using a standardized representation. A class is a template containing mutual properties of a group of objects. Types of the objects, classes, may be everything from physical objects, e.g. tank, to abstract objects such as plan and task. A more general definition of the class concept is that the class is a set of objects with the same behaviour which are of the same type. “Object-oriented methods also provide means to increase reuse of design efforts, including the concepts of patterns and the generalization/inheritance relation. These means offer the possibility to describe problems and to model properties of objects in a generic fashion, considering only common features before instantiation for the specific case”.

When we want to describe a class model in UML we first identify interesting classes and after performing hat step we describe relations between them. Consequently, we make a generic structure that can be used for implementation for different purposes. The first step towards a UML modelling was to collect knowledge about military organization and military behaviour. Most of this knowledge has been collected from doctrine manuals. In our model we use a representation of Swedish doctrines, although in generic manner. By using this kind of modelling approach, the UML structure can be reused/generalized to model other regular military organizations with some modifications. Doctrines provide hints about how military tasks should be carried out. This means that some of the military behaviours can be classified. Given information about environment, force balance, opponent’s position and other rules that have influence on military behaviour we can say that some behaviour are more probable to occur in some situations. UML has a very good

expressive power for classification. Class diagrams in UML give very good overview but we cannot say anything about the probability that a given class, in this case a class describing a particular behaviour, will occur. E. g. we found it difficult to express how using UML a class representing frontal attack behaviour of some hostile military unit is likely to occur given the information that we are close to the enemy and the fact that visibility is good. In some cases certain classes are irrelevant and in other cases they are important. Relations between attributes of different classes cannot be represented in UML class diagrams. Instead, in a UML class diagram we specify relations between different classes. On the other hand, the advantage is that the principle of encapsulation makes it possible to build implementations that have parts which are more autonomous, objects in UML. We see the attribute as a generalization class of class variable in UML. The model in Figure 1 is developed and improved from an even more generic model of C2, see [3]. The interpretation of the figure above is that one *Platoon* consists of three or four *Groups*, one *Platoon Commander* and one *Deputy Commander*. The *Platoon* has an attribute *Formation* with four possible values: Lead, Battle Line, Stepped Formation and Battle Triangle. This variable, attribute in UML, will be represented in BN with these values. *Platoon* is an Organization. The subset of *Physical Resource* class is a class of *Technical Artefact* which contains attributes that correspond to the technical equipment of the platoon in this case. As we see in this class diagram we do not have any description of relations between attributes.When modelling a hostile military organization we do not always have complete information about it. E. g. we may not know how many tanks an enemy tank platoon consists of. Let us say that in other cases hostile platoon consists of three or four tanks, in some cases there are also some other vehicles in

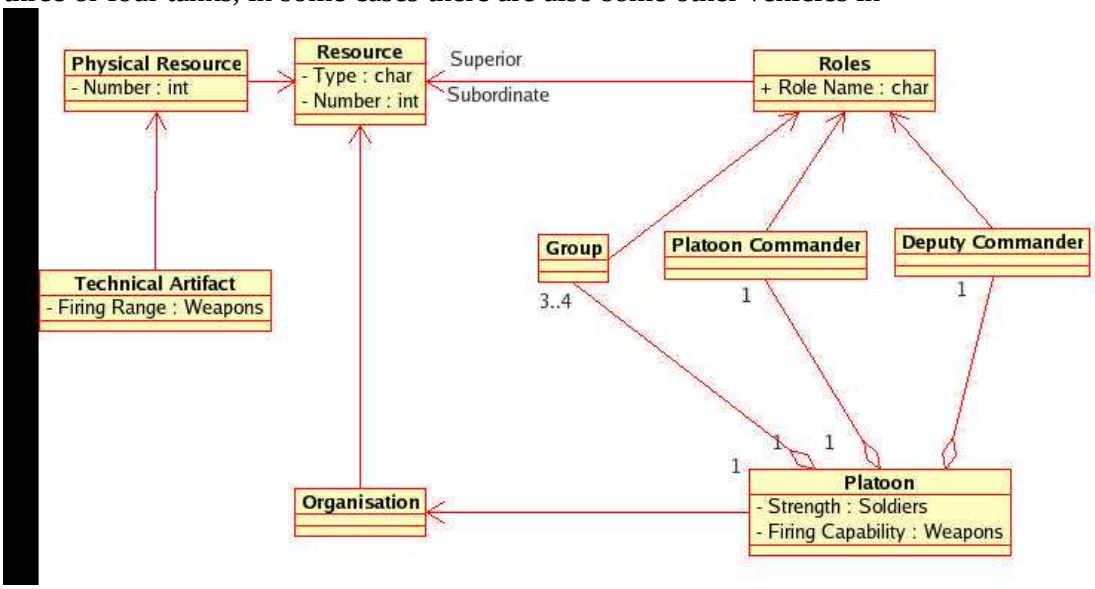

Figure 1: UML model of a platoon

a platoon. In UML we can express this relation as “the platoon consists of three to four groups”. A statistical interpretation of that statement may be the uniform Distribution over the number of groups. That implies that the hypotheses three and four groups are equally probable. There is no convenient way in UML to express for example our

knowledge that four groups is more frequent than three groups. A deficiency of the UML is its inability to represent uncertainty in a comprehensive way.

3. UML Doctrinemodel: In Figure 1 we showed the model of a platoon. In the same manner Figure 2 shows a company model. This model also represents the relation between company class and platoon class hence obtaining a hierarchical representation.

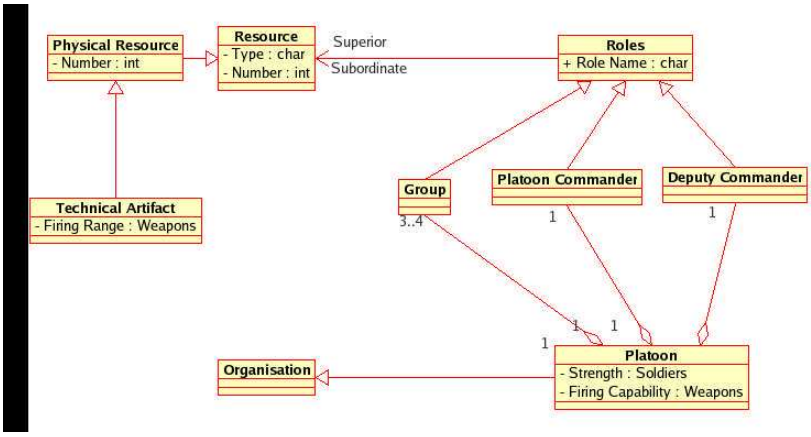

Figure 2: Company description with UML

It is not enough when modelling military doctrines to describe relations between different units, their roles, which resources are they part of, and which resources are put to their disposal. Military behaviour is however an important part of doctrines that is not part of the model. In concrete situations there is a list of the military behaviours/actions to be executed. In Figure 3 we show a model in which relations between military behaviour as a part of planning, military organization and environment are represented. We recognize this kind of problem in AI as the agent planning problem under uncertain. As we see in Figure 3, environment rules and doctrine rules are subsets of more general rules in an agent planning problem. Utility-based rules represent all rules that are not described in manuals but are frequently used. Some military or paramilitary organizations, for instance, lack doctrine rules. Plan and task are assigned to the role which can be for example a commander of a military unit or tank driver. In order to solve the task and execute the plan a role has to use resources. The role can be part of a larger plan and be subordinated to a resource, e.g. platoon member is subordinate to platoon.

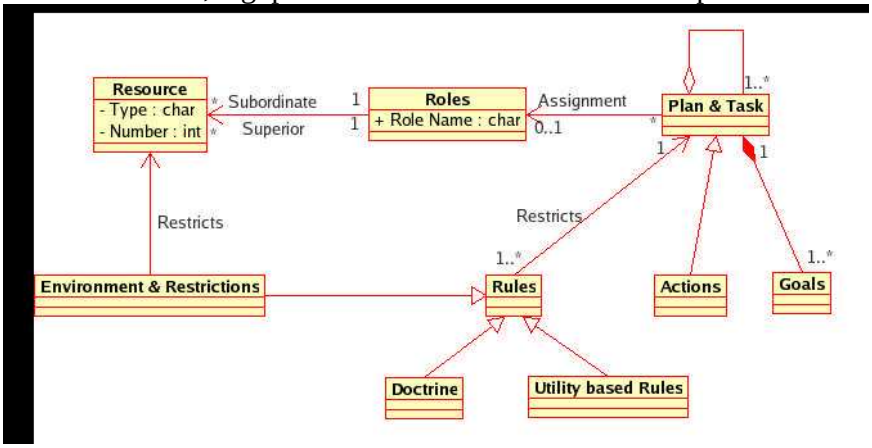

Figure 3: Planning, doctrine and environment

Part of the model is also the environment, which plays an important role when making plans. It is regarded by military commanders both as opportunity and as restriction to execution of their plans. Information about the opponent is also important when making own plans. However representation of some "generic" opponent is not performed in our UML diagrams, although it was modelled with our BN model of a particular hostile tank company.

4. UML Inmodeling Dynamic Aspects For Military: The object-oriented paradigm is a generic concept that is often applied in Software Engineering, but that is still valid while modeling any kind of systems. Objects will have a state, behavior and identity. The behavior may depend upon the state and the state may be modified by the behavior. Military Modeling uses intensive behavioral modeling, which can be easily represented by UML Dynamic Diagrams (State Chart, Sequence Diagram and Activity Diagram. Here we are demonstrating Anglo-American strategy, which was used during the Second World War, confronted with the might of Germany; the Allied Forces started reclaiming the portions of Europe captured by Germany. They used indirect approach by invading Europe from the South. The following diagrams provides a generic representation of the Anglo-American Strategy.

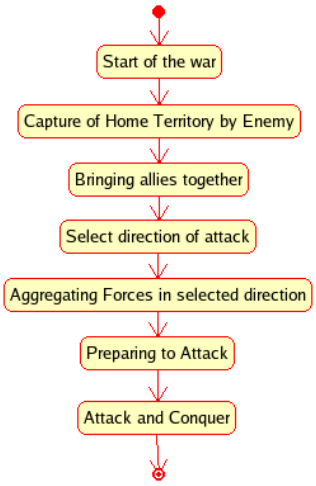

Figure 4:Anglo-American Strategy(ActivityDiagra

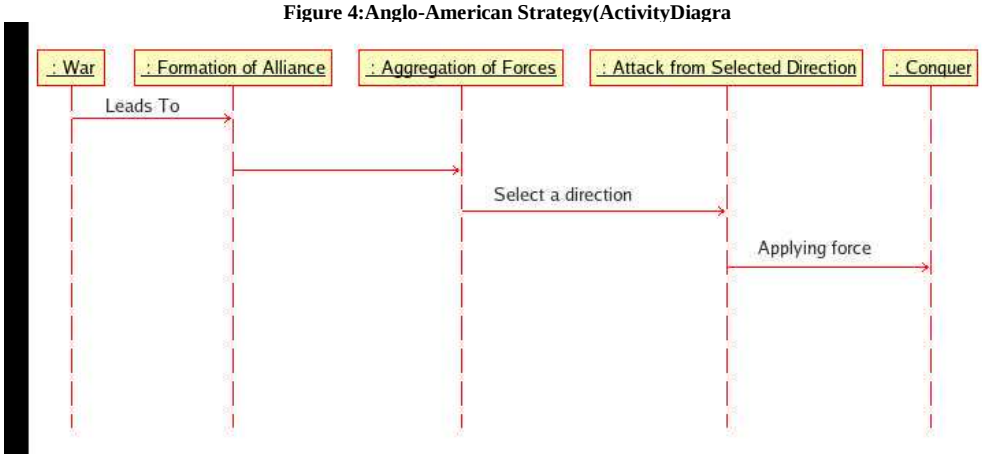

Figure 5:Anglo-American Strategy(Sequence Diagram)

5. Conclusions: This paper demonstrates use of UML in description of military architectures. Considering the transformation affecting military affairs and complexity associated to military systems, a review of contexts within which the profile will be used had to be done and presented. The management of military acquisition using the new Capability-Based Planning involves an enlargement of traditional System Engineering perspectives that was used in threat-based planning. An approach that considers mature engineering disciplines with new theories and that allows the production of holistic architectural descriptions at enterprise level appears as a potential solution in the context of Capability-Based Planning. In this context, architecture descriptions must allow the representation of any relevant concepts and links between them, no matter the domain or the project. The UML modeling language representation of Military Modeling was presented as a potential solution to these problems.There are many advantages of using our dynamic definition of system that was presented (Figure 4,,5). One of them is that some of the methodologies that will be identified and defined to address complex problems which may potentially be reused to address the same kind of problems for other kinds of situations.Thus from the above discussion, we can conclude that UML can provide an efficient way for representing military behaviour and military organization. The representations are generic and can be implemented based on the requirement.This paper also helps to reduce the complexity of information representation in military systems There is some problems with UML representation in Military. Confidentiality is an important aspect of military system. Because of its strategic importance, access to information regarding such systems should be very restricted. UML Awareness is also necessary. Some objects of military can not be modelled efficiently with conventional UML elements like Health status, geographical information. UML can beextended for better modelling of military objects.

6. References

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