Characterizing Doctrine through a Formalization of C2 Processes

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Content of the Presentation

1. Examining Doctrine
2. Engineered Knowledge
3. A Formal Linguistic Approach
4. Examples
5. Conclusion

Hypothesis

Complex Reasoning about Complex Endeavors using automated tools requires a comprehensive knowledge of Command Intent. A necessary step towards capturing Command Intent is the formalization of Doctrine and Mission Context. In our work presented here, we show:

- a pragmatic approach to knowledge acquisition, which we call Engineered Knowledge;
- a Formal Language for communicating Command Intent (using the pragmatics of Engineered Knowledge).

Examining Doctrine

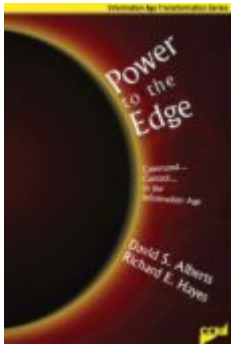
Definition

"**Fundamental principles**
by which the military forces or elements
thereof **guide their actions** in support of national objectives.
It is authoritative but requires judgment in application."

Joint Publication (JP) 1-02,
DoD Dictionary of Military and Associated Terms

Examining Doctrine

Doctrine and Agility



Alberts and Hayes (2003, p. 27) list four assumptions for **self-synchronization**, the ultimate goal of an agile organization:

- **clear and consistent understanding of command intent**;
- high quality information and shared awareness;
- competence at all levels; and
- **trust** (in information distributed, in subordinates, in superiors, and in equipment).

Examining Doctrine

Doctrine and Agility

"The common doctrine, training and education gave commanders an inherent trust in the ability of disparate units to cooperate effectively on the battlefield."

Murry & Scales (2003): *The Iraq War*.

Doctrine → Trust → Agile Operations

Examining Doctrine

Disadvantages of Doctrine

Organizations collaborating in a complex endeavor all have their own different doctrines. However, most people tend to think that their collaborators will act according to their own doctrine.

This results in misunderstandings.

⇒ The organizations participating in an endeavor have to communicate their doctrines in an unambiguous way / language.

Engineered Knowledge

Engineered Knowledge consists of knowledge about

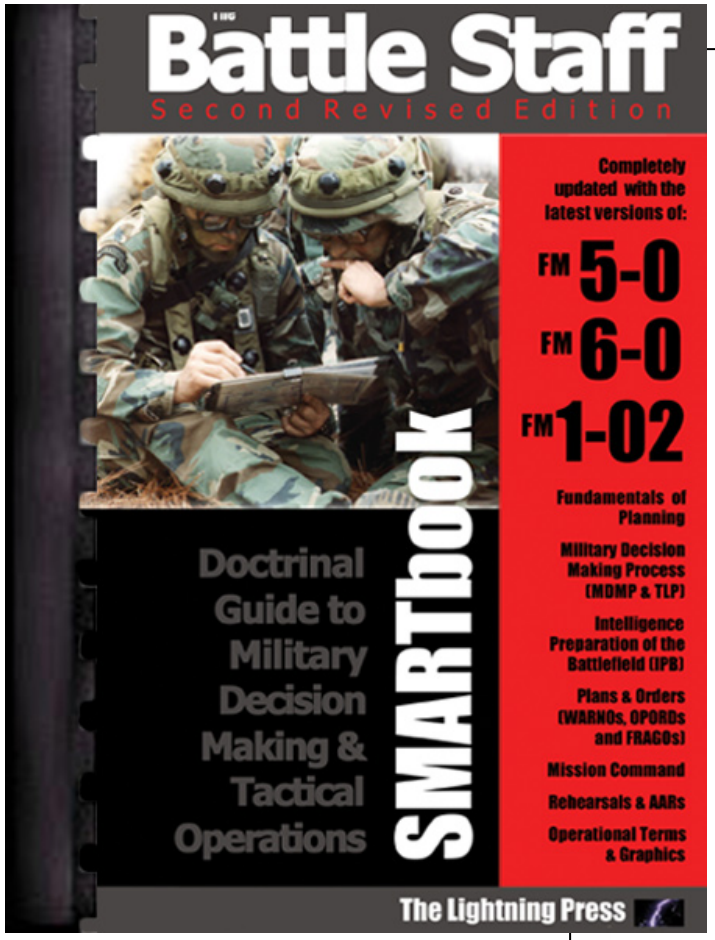
- an Organizational **Structure (Who)**
- the **Actions** the Organizations (and their parts) are able to perform **(What)**
- the **Purpose** behind the Actions (what kind of action is used to reach what kind of goals) **(Why)**
- **Geospatial Objects** that are essential to specific actions **(Where)**

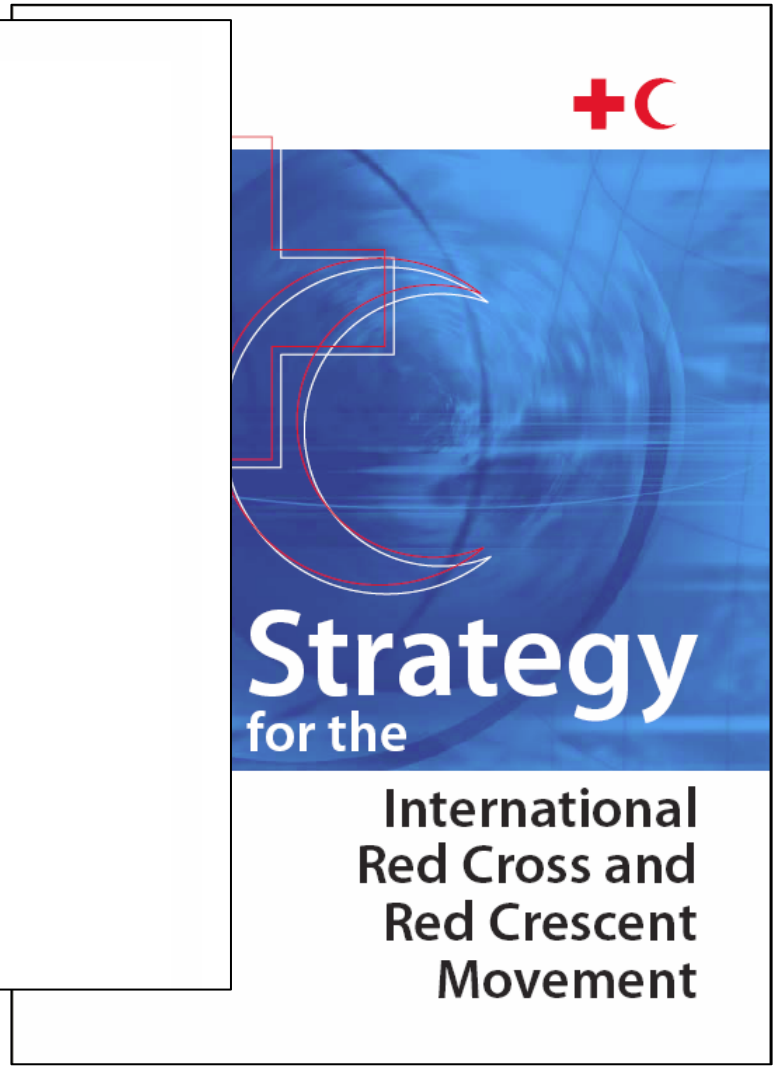
Engineered Knowledge

The *process* of building Engineered Knowledge involves acquiring the following information:

- the organization to be supported, its roles, functions and operating entities;
- the position/functions of the organization to be supported;
- the information needs of the decision makers and supporting staff of the organization;
- the processes to be supported;
- the specific input and outputs of the processes; and
- the communications requirements and methods between the processes and the positions/functions of the organization.

Engineered Knowledge





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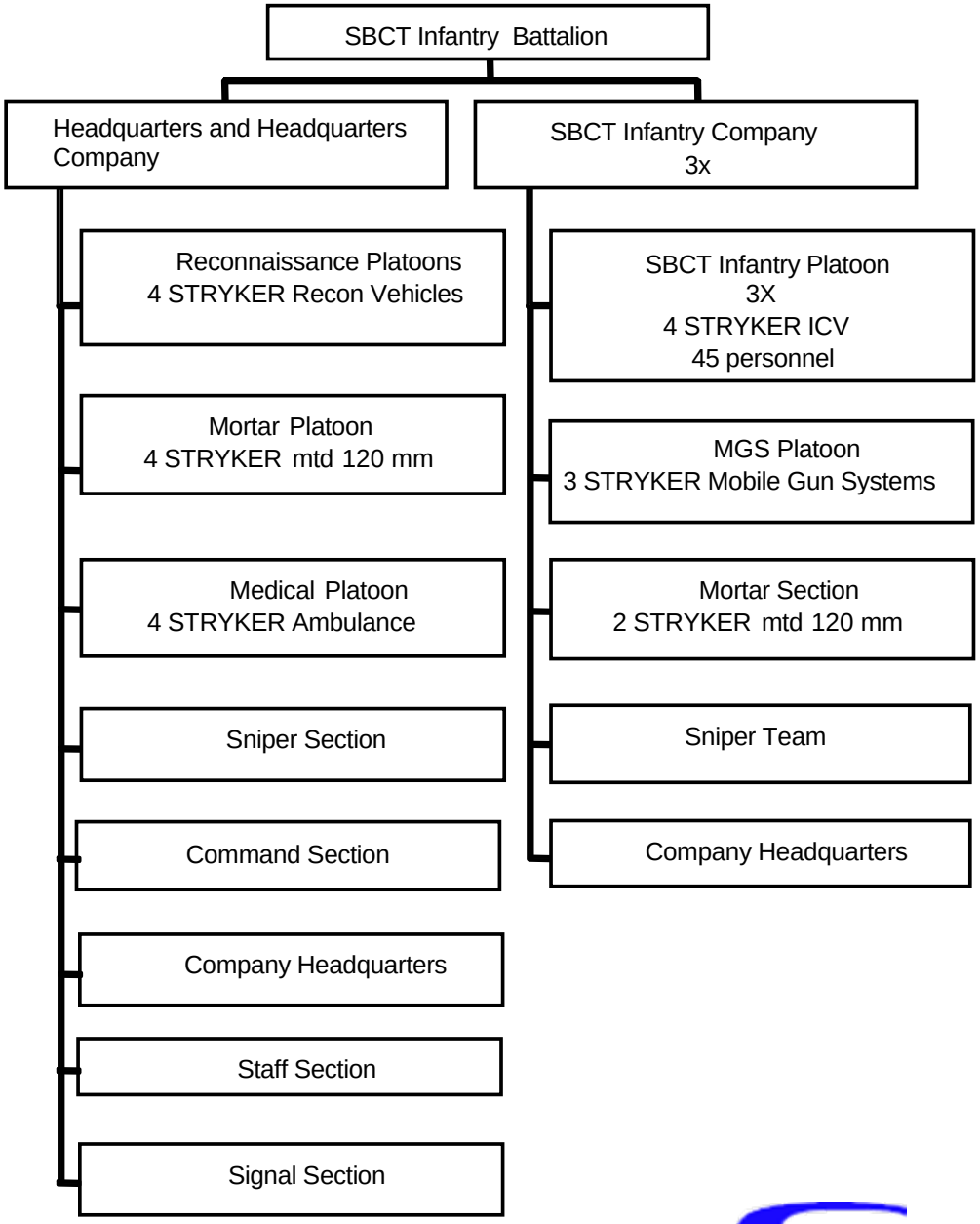
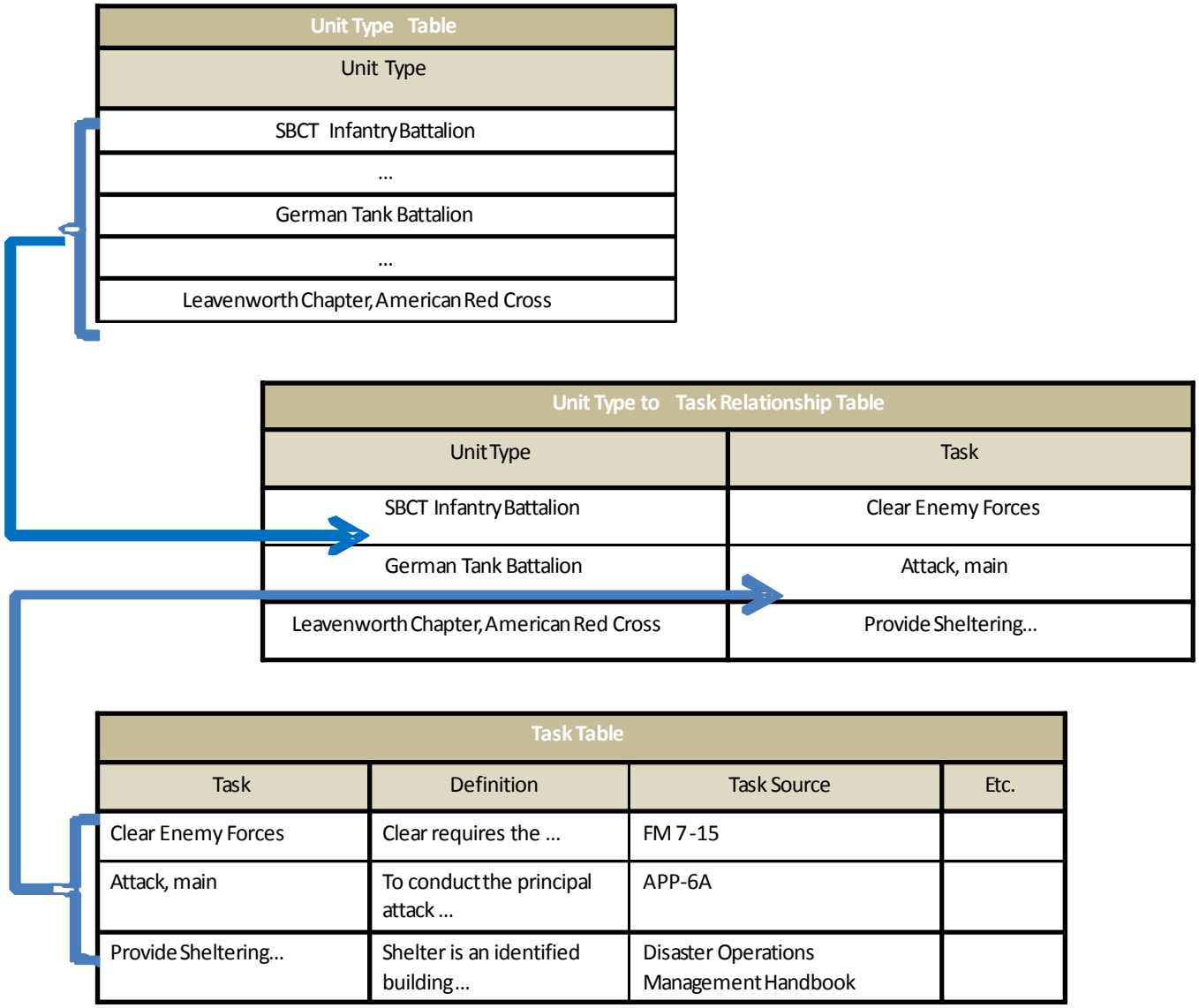
Engineered Knowledge

Organizational Structure



Engineered Knowledge

Actions that Units are capable of performing



Unit Type Table
Unit Type
SBCT Infantry Battalion
...
German Tank Battalion
...
Leavenworth Chapter, American Red Cross

Unit Type to Task Relationship Table	
Unit Type	Task
SBCT Infantry Battalion	Clear Enemy Forces
German Tank Battalion	Attack, main
Leavenworth Chapter, American Red Cross	Provide Sheltering...

Task Table			
Task	Definition	Task Source	Etc.
Clear Enemy Forces	Clear requires the ...	FM 7-15	
Attack, main	To conduct the principal attack ...	APP-6A	
Provide Sheltering...	Shelter is an identified building...	Disaster Operations Management Handbook	

Engineered Knowledge

The end product of Engineered Knowledge consists of:

What Codes (From Doctrinal Manuals)

- Description, reference

Why Codes (From Doctrinal Manuals)

- Description, reference

Association Tables

- Who – What Association
- What – Why Association
- What – Where (Terrain Products) Type Association

A Formal Linguistic Approach

For effective results doctrine and intent should be communicated among organizations participating in a complex endeavor.

Thus, as has already been made clear,
doctrine must be expressed in language, and
this language has to be formal in order to ensure

- clarity (unambiguousness) and
- automatic processing.

A Formal Linguistic Approach

In the past, we already designed a formal language for military communication and its underlying grammar,
the Command and Control Lexical Grammar (C2LG).

This language has been used by NATO MSG-048 “Coalition Battle Management Language” for giving orders to simulated units and for receiving reports from simulation systems.

The language is build on linguistic principles.
It uses so-called “constituents” as building blocks
as meaning can be assigned to these constituents in an unambiguous way.

A Formal Linguistic Approach

Words grouped together by some rule build a constituent.

In the statement: *4 civilians rescued at Prinz Willem-Alexander Brug*

"4 civilians" as well as *"at Prinz Willem-Alexander Brug"* form constituents.

Constituents fill "thematic roles" like "Affected" or "Location" what is called the **5 Ws** in the C2 world (although there are more than five thematic roles according to linguistic theories). So, knowing the 5 Ws you know the essence of constituency.

A Formal Linguistic Approach

A formal language is defined by a formal grammar.

A formal grammar consists of

- a lexicon (providing the words that are allowed) and
- a set of rules (telling how to combine the words).

<u>rule example</u>

NP	→	Numeral	Adjective	Noun
Agent	→	Count	Hostility	AgentType
		2	*neutral*	*civilian*

A Formal Linguistic Approach

The lexicon must be well defined in the context of operations to facilitate exchange information, ensure coherent results and support automated reasoning.

Therefore, for the C2 domain, we use the Multilateral Interoperability Programme's (MIP) semantics as specified in the Joint Command Control and Consultation Information Exchange Data Model – JC3IEDM.

A Formal Linguistic Approach

The basic rule for directives in the C2LG is

DB → CatT: Verb Sender Addressee (Affected|Action) Where
Start-When (End-When) Why (Mod) Label

CatT is a Categorization Term that indicates the type of statement [Order, Request, Report, Doctrinal Statement]

All the “Non-Terminals” (Verb, Sender, Addressee, ...) are place holders for respective constituents.

A Formal Linguistic Approach

Example

request: ***provide accommodation*** SBCT Inf Bn Red Cross **at** Melkar Square **start** at now label 2-b-103;

By this basic request, the Striker Brigade Infantry Battalion (SBCT Inf Bn) asks the Red Cross unit they are collaborating with for shelter for some displaced civilians. The “verb term” used is “provide accommodation” taken from JC3IEDM’s table “action-task-activity-code”. After the exchange of doctrine, the Red Cross has access to the definition of this term (equivalent to their term “*provide sheltering*” and thus can interact as intended.

A Formal Linguistic Approach

The C2LG already defines how directives and reports are formulated. It also provides formats for expressing Intent.

What is still missing are formats (grammar rules) for how to express doctrinal statements.

A Formal Linguistic Approach

basic rule for a Doctrinal Statement (DSB)

DSB →

doctrinal statement:

Organization

doctrinal aspect

Relation Argument*

Label

the organization the statement is about

the doctrinal aspect it is about

the content of the statement

a unique label that the statement can be referred to with

Examples

doctrinal statement:

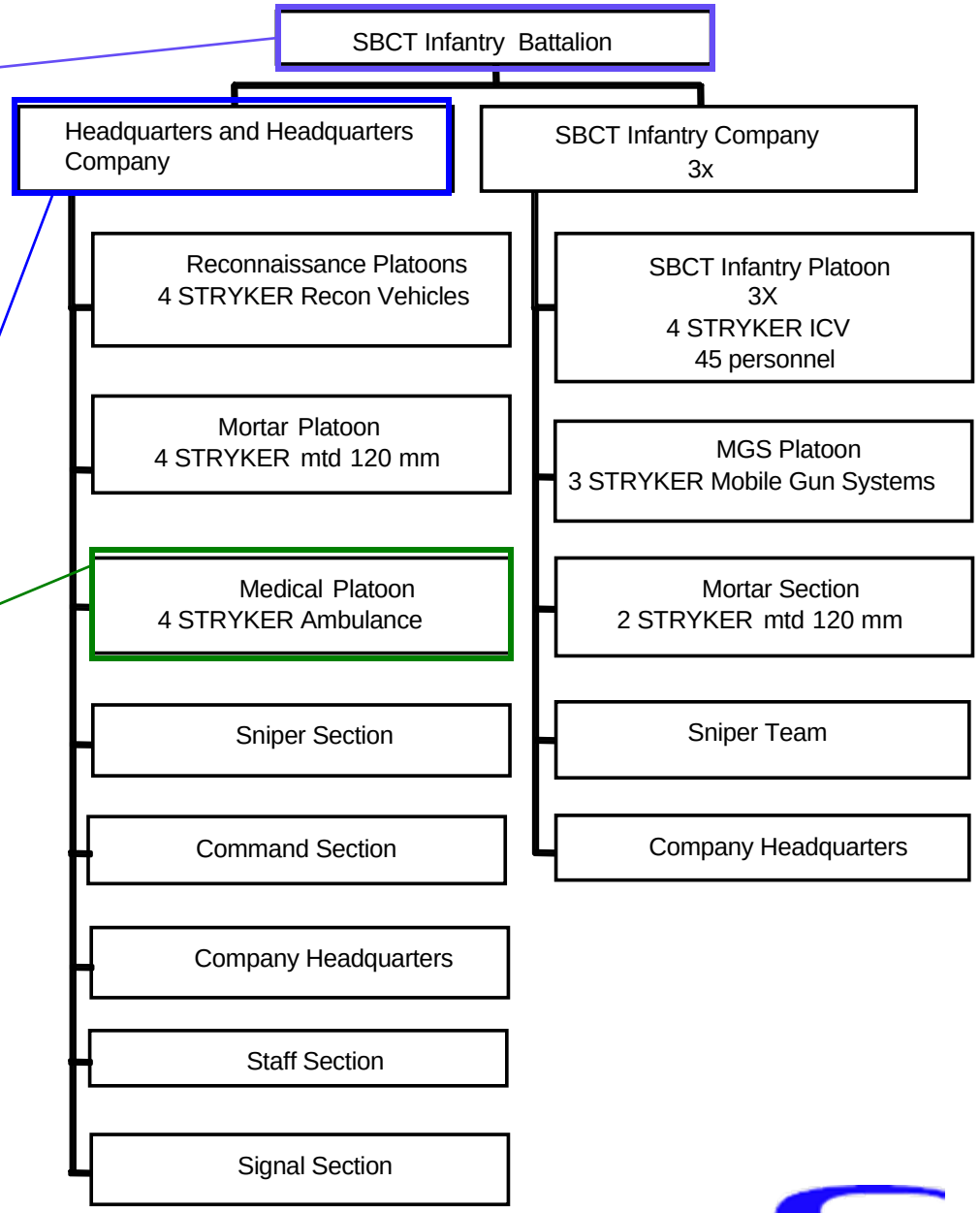
SBCT Inf Bn

organizational structure

CMDCTL HHC Medical Plt

label-ds-168;

CMDCTL is a JC3IEDM term indicating a C2 relationship between two Units



Examples

doctrinal statement:

American Red Cross Leavenworth Chapter

action capability

able to perform provide sheltering

label-ds-269;

"provide sheltering" is a Red Cross term from their "Disaster Operations" Management Handbook

Conclusions

- We have shown a pragmatic approach – Engineered Knowledge – to capturing an Organization's Doctrine.
- This Engineered Knowledge can be used to formulate complex missions and to facilitate aspects of Command and Control.
- We describe a formal language for Command and Control that allows communicating Mission Context using the pragmatics of Engineered Knowledge.
- We hypnotize that sharing of Engineered Knowledge improves Organizational Familiarity and Trust.

Thanks for Your Attention !

Questions and Comments are appreciated.

Semantics for C2LG – JC3IEDM

Comprehensive

Allows for Extension

Very well documented

- Tables
- Attributes
- Relations

Provides Core C2 Semantics