18th ICCRTS: C2 in Underdeveloped, Degraded and Denied Operational Environments

“The Operations Intent and Effects Model: A Command and Control Methodology for Increased Automation”

Topic 1: Concepts, Theory, and Policy

Topic 2: Approaches and Organizations

Topic 4: Collaboration, Shared Awareness, and Decision Making

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### Abstract

Command and Control (C2) is viewed as an increasing important part of future military technologies. While recent C2 theory has focused on desirable features of complex organizations such as Agility, and emerging work is looking at social media approaches, the key issues for many nations and programs are how to integrate and benefit from increased automation. Rapid advances in Robotic and Simulation technologies are very apparent and challenge the current C2 methodologies that rely upon intensive human intervention and monitoring. Future C2 will need to accommodate mixed forces of Humans and Robots. The uncertainty inherent in an actual mission, and the variety of potential organizations that support the mission after it is underway, makes Command Intent (CI) a critical concept for automated C2 systems. Both humans and decision support services (including simulations) within a C2 system need to have the ability to communicate and interpret a shared CI. The Operations Intent and Effects Model (OIEM) identifies the relationships between Intent, Actions, and Effects in a C2 framework. We describe this model and show how it can represent and support operations as well as enable the design of more effective C2 systems in the future.
The Operations Intent and Effects Model: A Command and Control Methodology for Increased Automation

Abstract

Command and Control (C2) is viewed as an increasing important part of future military technologies. While recent C2 theory has focused on desirable features of complex organizations, such as Agility, and emerging work is looking at social media approaches – the key issues for many nations and programs are how to integrate and benefit from increased automation. Rapid advanced in Robotic and Simulation technologies are very apparent and challenge the current C2 methodologies that rely upon intensive human intervention and monitoring. Future C2 will need to accommodate “mixed” forces of Humans and Robots.

The uncertainty inherent in an actual mission, and the variety of potential organizations that support the mission after it is underway, makes Command Intent (CI) a critical concept for automated C2 systems. Both humans and decision support services (including simulations) within a C2 system need to have the ability to communicate and interpret a shared CI. The Operations Intent and Effects Model (OIEM) identifies the relationships between Intent, Actions, and Effects in a C2 framework. We describe this model and show how it can represent and support operations as well as enable the design of more effective C2 systems in the future.

1. Introduction

The explosion of new Information Technology has profoundly affected modern military forces. In no area has this change been as drastic as has the impact on C2. As well as providing unique new capabilities, the new Information Technology has posed significant challenges in the area of C2 acquisition and development. Modern military forces are being forced to adopt Commercial Information Technology for C2 uses due to the slow pace of innovation in military acquisition and development. An example is the impact of “Smart Phones” on current militaries and their C2 infrastructure.

However, while the new capabilities provided (e.g., more computing power, better communications) are eagerly embraced by the warfighters, they provide a challenge in how they integrate into the C2 infrastructure. Beyond this challenges, there is the issue of how the new capabilities can be optimally used to accomplish missions. Rapid advanced in Robotic and Simulation technologies can supplement current C2 methodologies that rely upon intensive human intervention and monitoring (Borgers, et al., 2008).

While the advantages of Agility and Robustness for C2 theory have been empathized in recent work (Alberts, 2007; Alberts and Hayes 2007), there is a competing need to develop dedicated C2 technologies and specific services to accomplish specialized missions. State of the Art C2
systems are geared toward “Sensemaking” – developing Situational Awareness and are starting to perform predictive analysis. There is still a very limited capacity to integrate the increasingly sophisticated robotics and simulation technologies.

The research presented in this paper addresses the problem of developing and integrating new technologies into C2 technologies and processes. A new methodology is presented that is oriented towards the development and integration of new technologies. The OIEM was developed to both portray a generic C2 process (applicable to operations conducted by Military, Civil, and Non Governmental Organizations) as well as represent those elements necessary for developing both Intent and Situational Awareness, key to using C2 to accomplish missions.

In this paper the OIEM is presented and described in detail. More detail on related C2 models (such as the Observe, Orient, Decide and Act (OODA) Loop (Boyd, 1987)) can be found in (Gustavsson, 2011), as well as the application of this model. The OIEM model is a general and high-level description of C2 information constituents, their relations and causality in the view of an organizational planning context. The paper concludes with a discussion about the applicability of the model.

2. Operations Intent and Effects Model (OIEM)

Figure 1 presents the OIEM, a model of Operations as it relates to general C2 and decision-making processes. The world is represented and bounded by an Initial-State, Current-State and End-State.

The model is based on Curts & Cambell’s (2006) Generic Command and Control Process Boyd’s, (1987) OODA Loop, and Brehmer’s Dynamic OODA Loop together with military decision making models such as United States (US) Military Decision Making Process (MDMP) (US Army 2005) and Swedish Armed Forces (SwAF) Integrated Dynamic Command and Control
The OIEM has been developed and enhanced over several years concluding in (Gustavsson, 2011). In the author’s first version (Gustavsson, et al., 2008b), the main characteristics of the model were introduced identifying Intent, Initial-State, End-State, Orders, Actions, Effects, Goal and their relation to Decision Making. In Gustavsson, et al., (2008) the model was enhanced to better express the causalities and relations in the model. In Gustavsson, Hieb, and Wemmergård (2009) “Commander’s Intent” was replaced with “Command Intent” to better represent the collective effort in developing Intent, together with the insertion of plural forms of Actions, Orders, and Effects since there is not just one order, action or effect that leads towards an End-State. In Gustavsson, et al., (2009) the Command Intent was replaced with the general term of Intent to encapsulate all forms of Intent. For clarity, boxes were introduced for all information elements including Mission/Goal and Intent. The model presented in Figure 1 has been further enhanced to incorporate Current-State, and show that Intent “guides” the implementation of Actions. The purpose of the changes made is to further clarify the role of Intent in a C2 process and its relation to other C2 information elements.

In the OIEM C2 information elements are represented by rectangular boxes, circles and octagons. The Decision Making (DM) box describes the process using and generating information that is reviewed and conveyed in the organization. Block arrows present the relations and causality from the perspective of the Initial-State and illustrate the main flow in Traditional C2 planning, i.e., forward chaining. Dashed arrows represent the perspective from the End-State information object and illustrate Effects-Based planning, i.e., backward chaining. The solid arrows emphasise the Intent relations between Decision Making and Intent, Intent and Actions, and between Intent and End-State.

The general flow in the model is that the DM process perceives the Goal and the Initial-State, often provided by a higher Command Authority. The DM process then develops an Intent that can be either explicit or implicit. The Orders normally contain the explicitly stated Intent. In Traditional C2 planning, the Orders are developed by assessing the possible Actions that will lead towards the desired End-State. In Effects-Based Approaches the Orders are developed by assessing the End-State and the possible Effects that will lead towards the End-State. The content of the Orders produced then either focuses on the Actions to be performed (as in a Traditional Planning Process) or on the Effects to be accomplished (as in an Effects-Based Planning Process). Regardless of which planning paradigm is used in the in the DM process, the Actions produce Effects that are monitored and change the Initial-State into a Current-State. The Current-State is then analysed with respect to the End-State. If the End-State is not reached, an assessment is made (deliberate or hasty), and eventual new orders are produced.

The following subsections describe the model into more detail.
2.1 Decision Making Process in OIEM

The DM should be seen as a container for the decision making process of choice conducted by commanders. In Figure 2 the DM is presented together with its main information objects. The DM in a C2 context can be illustrated with the eight steps derived from the MDMP as outlined in Army Field Manual 5-0 (U.S. Army 2005).

Step 1) Receipt of mission / Initiation

A goal is externally delivered, interpreted and adopted into the internal system or developed internally in the system.

Step 2) Mission Analysis / Orientation

The next step according to the MDMP is to search for and make use of information. In OIEM this is captured by the Perceives and Perceived by arrows. If there is a need for more information, that request is made, and is in itself, an order consisting of actions or effects to be accomplished, e.g., retrieving information in a certain area regarding some specific objects. Therefore there is no explicit arrow for request of more information in the figures. Within the model the perception, comprehension and projections of information is within the DM process. The Initial-State and Current-State are representation of information.

Steps 3-6) Course of Action Development, Analysis, Comparison and Approval / Decision

The development of a Course of Action (COA) and a Course of Effects (COE) is an internal DM process where strategies such as forward and backward chaining are used. In the MDMP the decision making process receives a mission goal and perceives an Initial-State. A concept of Intent and End-State is developed. In a forward chaining process, the decision making process receives a mission goal and perceives an Initial-State. A concept of Intent and End-State is developed. Then the question is, what actions can cause effects to change the Initial-State towards the End-State? The next feasible state is used as a new turn, the next after that, and so on. Eventually the End-State is reached and within the DM process a selection amongst alternatives is made and Orders can be produced.

[Depending on the C2 method used, the Analysis processes can differ. In a traditional setting, several COA/COEs are evaluated and judged against each other. The best COA/COE, according to a predefined set of criteria, is selected. For example, a criteria for Recognition]
Primed Decision Making might select the first developed COA/COE that will fulfill the objectives.]

Step 7) Orders Production / Plan Development

From the process of developing COAs and/or COEs Orders are developed containing the information normally following a standard military five-paragraph order structure or at least the Who, What, When, Where and Why (5Ws) structure.

Step 8) Review

When the Orders are set into action, the effects will change the Initial-State into a Current-State that is perceived by the DM process. The DM process evaluates the Current-State towards the End-State, Intent and Goal. Depending on the outcome, the result could be that the mission is completed or that, depending on the magnitude of change, either Fragmentary Orders (FRAGOs) or new Operations Orders (OPORDs) are made.

2.2 Goal in OIEM

Figure 3 presents how Goal relates to DM. Decisions are made by purposeful systems, meaning that there is an underlying goal for the system to pursue and that there is some sort of decision making process that supports the achievement of the goal (Ackoff, 1999). A goal is either internally developed (within a humans mind or within an organization), or is an externally disseminated goal. Within the author’s work (Lagervik and Gustavsson, 2006) a goal is important for a purposeful system. Internal goals are the goals that an organization or individual develops. External goals are derived from mission statements or from Intent statements (and in a military setting derived from higher commanders OPLAN or OPORD). The word “goal” is chosen to represent all the types of statement that provide the purpose and rationale for the operation and guides the DM process.

Therefore, a goal can describe what the effects ought to result in, and the goal identifies the higher intent, i.e. intent from a higher commander or organisation. From a collaborative cooperative view, a goal is the overarching unifier for the teams.

2.3 Initial-State / Current-State in OIEM

A C2 process incorporates the search for more information. This information is then used as a basis for the decision making. For this work, a state is said to describe a condition or parameters’ values at a certain time. A state is produced by a situation assessment process shown in Figure 4. There are many well defined models of Situational Awareness such as in Endsley (1995) or the Joint Directors of Laboratories (JDL) Model (Llinas, et. al., 2004).
The Initialization of such a process is made by the decision making process in the search for new or updated information.

An ongoing state is said to be current, a state that has been is said to be previous, and an anticipated upcoming state is said to be future; e.g., current: would be a battalion is moving into attack position; previous: the battalion has disembarked and marched to the designated area of operations; and future: the battalion will attack and seize the enemy. Depending of the purpose of what a state is describing, states may also have different sets and granularity of conditions and parameters. An object can belong to several states at the same time.

A state is not only physical; it also covers cognitive states, i.e., humans’ states of mind. The cognitive state will change over time and can range a whole set of attributes, e.g., consciousness, political, intention, goals, and will. Further, a state can also be informative in describing the capability and ability (e.g., that the battalion can attack ground forces); or, state of readiness describing to which degree a person or system can conduct a certain task (e.g., that the battalion has appropriate resources to conduct the task at hand).

An Initial-State is the starting state that is/was used during the decision making process. It can be physical, i.e., describing objects’ positions and actions; or, cognitive, i.e., describing a person’s and system’s state of mind; or, informative, i.e., describing objects, environment, person and systems.

Both Initial-State and Current-State contain the relevant information for that particular decision making process. In a military setting the Initial-State contains physical, cognitive, and informative information about own forces, enemy forces, other forces, civilians, other organizations, and the environment.

To assess the completion of the intent, plans, orders, tasks, actions, etc., the Initial-State is evaluated against the Current-State. From a planning perspective an intelligence product is often used that contains the previous state, the Current-State and assumed future states. This intelligence product is the Initial-State for the planning and decision making therefore the OIEM in Figure 4 incorporates both initial and Current-States.
2.4 Intent in OIEM

In Figure 5 Intent and its relation to the DM process, Actions and End-State is visualized. With this approach Intent is captured to be an output from a DM process regardless if it is implicitly or explicitly declared. The representation of Intent follows Klein (2008). The End-State in OIEM can be described through the three Intent facets: Goal, Antigoal, and End State. Goal describes the high-level purpose of the desired outcome, i.e., the rationale; Antigoals describe unwanted outcomes; and, the End State describes the more detailed desired outcome. The guidance to Actions is described mainly of the remaining four facets of Intent: Initial-State, Sequence, Key Decisions, and Constraints. The Initial-State describes the situation and assumptions when the Intent was developed, Sequence directs the order of actions, Key Decisions provides the most important decisions that are expected to occur, and Constraints provide the rules of engagement and the consequences of external events (e.g., weather and populations). We note that in current NATO and US doctrine Sequence and Key Decisions may not be specified. With this approach Intent is modelled in order to support a DM. The Initial-State described in the intent statement is equal to the Initial-State presented in the OIEM.

2.5 Orders in OIEM

Orders are well rooted in military doctrine, and from the military decision making perspective the output is often a Warning Order (WARNO), OPLAN, OPORD, FRAGO, or an Air Tasking Order (ATO). In other Organizations (e.g., Police, Fire Departments) there are also well-specified formats for Orders. Orders are disseminated to subordinates to be executed. For the OIEM the wording orders are used to encapsulate all formal written orders along with simple direct vocalized orders. The focus for OIEM is the information specified in the OPLAN/OPORDs first three paragraphs of Situation, Mission, and Execution since these are oriented towards the actions to be performed. In Situation the Initial-State of Own, Friend, and Foe are described. Mission describes the Goal, i.e., internally or externally developed as described in Section 2.2 above. Finally Execution conveys Intent, COAs/COE, tasks to subordinates and tasks to supporting organizations. The purpose of the Orders is to provide coordination of actions to establish effects in the most effective area at the most effective time to move towards a desired End-State. That also is the core of Effects-Based Operations.
2.6 Actions in OIEM

An action is something that is executed by a system. The system can be technical or human controlled and can range from a single executer to a whole echelon of executers. In Figure 6 the OIEM action relations is visualized. The basic interpretation is that an action causes an effect. Several actions together can cause a specific effect and sometimes a single action causes several effects. Actions are described in an order. Here the order can be as vivid as an OPORD or OPLAN, or a verbalization of some simple direct action.

Standard Operating Procedures provide a set of actions that are applicable for a specific organization, echelon or individual, i.e., actor. How well an actor can perform an action is captured by its capability.

2.7 Effects in OIEM

The Effects-Based Operations approach can be seen as a method to model the causes between actions and effects, physical and behavioural as well as direct and indirect effects. This is captured in the OIEM by linking Actions to Effects by the arrow denoted “causes” as shown in Figure 7. This relation defines Effect-Nodes-Action-Resources (E-N-A-R) linkages.

Actions represent both low level actions executed by individuals (e.g., fire a weapon), and high level actions (e.g., mission executed by a Corps force such as operation Desert Storm). Effects represent both low level effects (e.g., impact of bullet), and high level effects (e.g., Enemy force defeated). Thus, separate actions can be represented by a higher level action and separate effects can be represented by a higher level effect. Further, one or more actions causes either a single effect or a set of effects to occur. An action of shooting causes the effect that some one gets hit. At the same time a side effect of revealing one’s own position is caused. If the person that got hit dies we have a cascading effect, i.e. Effects can be said to cause Effects.

2.8 End-State in OIEM

In Field Manual 5.0, (U.S. Army 2005) an End-State consists of those conditions that, when achieved, accomplish the mission. An End-State is described by the relationship between own forces and opponent forces, terrain, other people and organizations.

Figure 6 – Actions in the OIEM

Figure 7– Effects in the OIEM
The relationship of *End-State to Intent* is visualized in Figure 8. An *End-State* can be represented by graphics overlays, in matrices, or described textually. An *End-State* can either be direct (e.g., destroying a bridge, when the bridge is destroyed the end-state is reached) or abstract (e.g., secure airfield). Also an *End-State* can have a varied time span (e.g., for how long shall the airfield be protected, and for how long is the end-state valid to pursue?). Further, an *End-State* can be articulated in the *Effect* that should be gained. An *End-State* in an OPORD is usually in bullet form and it normally does not exceed five sentences. The use of *End-State* enables the subordinates, supporting organizations and collaboration partners to establish effects in the most effective area at the most effective time within the scope of the Intent. The *End-State* is described by the Goal, Antigoals, and End-State as defined in Section 2.4 above. The expected result from a series of actions-cause-effects is observable changes in the *Current-State*. If the Current-State meets the criteria of the End-State the OIEM assumes the *Actions* produced the End-State.

![Figure 8 – End-State in the OIEM](image)

3. **Challenges**

C2 is still a very human process, with fewer automated tools that support the planning and execution phases then the large number of C2 tools that provide situation awareness. In order to develop more sophisticated C2 tools, there needs to be a better integration of current and emerging technologies. An example is the current visualization technologies such as Google Earth. These have the potential to provide virtual simulations of areas where future operations will occur. Small Unmanned Aerial Vehicles will be available that can map large areas very accurately. But to integrate all of these technologies requires a guiding principle and the OIEM suggests that the concept of Intent may be the best paradigm to use.

There are various representations of Intent that can be used in reasoning systems. Many of these have been developed from the domain of Military Simulations (Carey, et. al., 2001; Gustavsson, et. al., 2008a; Schade and Hieb, 2006; Schade and Hieb 2007). However, there are only a few tools that can currently project *Actions* forward to determine if an End-State can be reached. While many Military Simulations can generate *Actions* from Orders, the specification of an End-State is currently a major technology gap. The End-State cannot be specified in such detail that it completely describes a complex world state, so the constraints in representing an End-State are critical.
There is a need to perform more assessment of different methods of developing intent as in (Farrell, 2004).

Similarly, the area of aggregation and delegation are difficult to implement in practice. While humans can delegate easily, the OIEM depicts a very simplistic C2 process. In actual operations there are many levels of goals, actions and effects. When reasoning systems can use intent, the orchestration of different goals will need to be addressed.

4. Summary

The OIEM captures Intent and Effects and the relations amongst C2 information elements along with C2 processes in a cohesive way and provides: 1) a model of Intent for C2; and, 2) a foundation for developing a new generation of tools to support C2 with new types of Information Technology.

Regardless of the C2 method, e.g., Traditional (North American Treaty Organization, 2005; U.S. Army, 2005), or Effects-Based, the OIEM illuminates the relationship between Intent and the other C2 information elements. For C2 tools the model is used to develop a formalism of Intent and related information elements. The model can be used as the basis for the implementation of Intent in Current C2 system (Gustavsson, 2011).

The OIEM captures the traditional approach to planning presented in the Generic Command and Control Process (Curts and Cambell, 2006), in that an order describes Actions that cause Effects. The Effects in turn change the Current-State into the desired End-State. The detection of the Initial-State (the state prior to the decision making and the time the Orders are given) means that the system where the decision making takes place must be able to perceive and comprehend the situation, and, from reasoning and projection, produce a plan that consists of an order that describes Actions to be executed. The observable Effect from the actions then changes the i to another state, i.e., Current-State.

In Effects-Based Operations (Smith, 2008) and Networked Enabled/Agility, Focus and Convergence (Alberts, 2007) the OIEM describes the relations between a desired End-State and the Effects that could cause it. With the relations from the End-State to Effects to Actions to the ability and capability of the force at hand, to find the first solution that might fulfil the mission. The OIEM supports the vision by Alberts and Hayes (2007) of a goal-seeking process that guides actions and effects, in that it allows templates to be constructed that describe Effects from various Actions. The model can then be used for both backward chaining as well as forward chaining. Backward chaining is supported by the search from End-State and Effects towards Actions and organisations that can execute the actions. Forward chaining is supported by using the Initial-State and actions that result in effects that changes state towards the desired End-State.

In a collaborative setting the OIEM provides a way to identify where there is a need to communicate plans, intentions and orders amongst staff members, joint and coalition forces and other agencies. The relationships, such as Effects to Actions, allow a commander to express the actions he selects with the understanding of how they can deliver the desired effects. This can be used at higher level command to assess the plans. The OIEM supports computational representations of intent will allow for human machine analysis (e.g., simulation).
Acknowledgements

This paper is based on Dr. Gustavsson’s PhD Thesis, which goes into more detail on related research as well as computational implementations of the OIEM.

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References


THE OPERATIONS INTENT AND EFFECTS MODEL:
A COMMAND AND CONTROL METHODOLOGY FOR
INCREASED AUTOMATION

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18th ICCRTS
20 June 2013
• Command and Control (C2) is viewed as an increasing important part of future military technologies.

• While recent C2 theory has focused on desirable features of complex organizations, such as Agility, and emerging work is looking at social media approaches – the key issues for many nations and programs are how to integrate and benefit from increased automation.

• Rapid advanced in Robotic and Simulation technologies are very apparent and challenge the current C2 methodologies that rely upon intensive human intervention and monitoring.

• Future C2 will need to accommodate “mixed” forces of Humans and Robots.
C2 AGILITY
GOP / MDMP etc.

situation

object

sensing

Observation

WARNO

OPORD
Collaborative Planning Under Time Pressure (PUT)

Initial
Intermediate order
Intermediate order
Completed order
Observation

sensing
object
situation
MATURITY MODEL

after Alberts & Hayes (2007)
SOCIAL MEDIA
expressives
Commander 1

expressives
Commander 2

expressives
Commander 3

expressives
Commander 4

Doctrine

WARNO, OPORD, FRAGO 1

WARNO, OPORD, FRAGO 2

WARNO, OPORD, FRAGO 3

WARNO, OPORD, FRAGO 4
Cope with Change

After NATO Network Enabled Capabilities, Hayes et al. Focus and Convergence (2008),

Gustavsson, 2010
AUTOMATION
Future C2 will need to accommodate “mixed” forces of Humans and Robots.
Battle Management Language

C2 Systems

Commander’s Intent
BML

Simulation Systems
- Live
- Virtual
- Constructive

Robotic Systems
Battle Management Language

C2 Systems
- Robotics (119 Schade)
- Cyber (111 Machado)
- Infrastructure SBML (021 Pullen)
- Infrastructure CBMS (121 Diallo)

Commander’s Intent BML
- Controlled Grammar (083 Poteet)
- C-BML (117 Heffner)
- C-BML SDL (122 Heffner)

Simulation Systems
- Live
- Virtual
- Constructive

Robotic Systems
- Live
- Virtual
- Constructive
FOKUS PÅ SITUATIONS FÖRSTÅELSE MEN

... INTEGRATIUS ...
Decision Making Process

**Knowledge**

**Information Fusion**

**PEMSII**
Political, Military, Economic, Social, Infrastructure, and Information

**DIME**
Diplomatic, Information, Military, and Economic

**WARNO, OPORD, FRAGO**
- Situation
  - SAw Adv
  - SAw Own
- Mission
- Execution
  - Intention
  - KeyPoints
- Service Support
- Command and Signal

**Subordinate Commander**
- Decide
- Orient
- Act
- Observe

**Real World**
Decison Making Process

Saw
Situation
Mission
Execution
Service Support
Command and Signal

Doctrine

Commander's Style

Knowledge

Experience

Real World

PEMSII
Political, Military, Economic, Social, Infrastructure, and Information

Situation
Mission
Execution
Service Support
Command and Signal

DIME
Diplomatic, Information, Military, and Economic

Subordinate Commander

Observe
Orient
Decide
Act

Effect
Intent is the state of mind with which an act is done and can describe the formulated or planned intention. (Merriam-Webster, 2009)
DEFINITION OF INTENT

- UK Army Doctrine Publication – Operations (DCDC 2010, para.0622) is the British Army’s capstone doctrine, containing the enduring philosophy and principles for the UK army approach to operations. “Intent is similar to purpose. A clear intent initiates a force’s purposeful activity. It represents what the commander wants to achieve and why; and binds the force together; it is the principal result of decision-making. It is normally expressed using effects, objectives and desired outcomes.”

- Swedish Armed Forces - Integrated Dynamic Command and Control (IDC2) (Josefsson, Marklund, and Hansson 2007) defines intent as “Intent is a concise formulation of the overall goals and purpose. The focus is to describe operations, restrictions and resource allocation.”

- Canadian Forces Joint Publication 5.0 (Chief of the Defence Staff 2008, 5E-2) “Commander’s Intent. This summary should provide the Commander’s overall intent and establish the purpose of the plan. It is an important focusing statement for subordinate commanders. (1) Military Objectives. (2) Desired Military End-State. (3) Transition Conditions”.

- US Field manual 5.0 (U.S. Army 2010, 2-90) constitute the US Army’s view on planning, preparing, executing, and assessing operations. “The commander’s intent is a clear, concise statement of what the force must do and the conditions the force must establish with respect to the enemy, terrain, and civil considerations that represent the desired end state (FM 3-0[1]). The commander’s intent succinctly describes what constitutes success for the operation. It includes the operation’s purpose and the conditions that define the end state. It links the mission, concept of operations, and tasks to subordinate units.”

- NATO allied Joint publication 1 (AJP-01) (NATO 2010, 0538) provide the keystone doctrine for the planning, execution and support of Allied joint operations. “The intent defines the end-state in relation to the factors of mission; adversary, operating environment, terrain, forces, time and preparation for future operations. As such, it addresses what results are expected from the operation, how these results might enable transition to future operations, and how, in broad terms, the Commander expects the force to achieve those results. Its focus is on the force as a whole. Additional information on how the force will achieve the desired results is provided only to clarify the Commander’s intentions.”

- US Joint Publication 3.0 (US Joint Chiefs of Staff 2010, IV-25) provides the doctrinal foundation and fundamental principles that guide the Armed Forces of the United States in the conduct of joint operations across the range of military operations. “Commander’s intent is a clear and concise expression of the purpose of the operation and the military end state.” and continues “It also includes where the commander will accept risk during the operation. The initial intent statement normally contains the purpose and military end state as the initial inputs for the planning process.”

- Other doctrinal work that has been used in this survey are US Field Manual 6.0 (U.S Army 2003, 1-68) describe doctrine on C2 for tactical Army echelons (corps and below), US Field Manual 3.0 (U.S. Army 2008, 5-55) presents overarching doctrinal guidance and direction for conducting operations and is one of the two capstone doctrine hand books for US army, SwAF - Regulations for ground operations (Regler för markoperationer) (SwAF 2009, 143) UK Glossary of Joint and Multinational Terms and Definitions (The DCDC 2006, pp.C-16)

INTENT CONTAINS

Intent

Initial State
- Initial State
- Sequence
- Key Decisions
- Constraints

Execution

Outcome
- Mission / Goal
- Antigoals
- End State

Klein
Dimensions of Intent

Commander’s Intent

Command Intent

Common Intent

Shared Intent

Increasing Hierarchy

Increasing Control
Explicit Intent
Publicly Communicated

Implicit Intent
Unvocalized (and unvocalizable)

Orders
Questions
Answers
Doctrine

Personal Expectations
(based on Style and Experience)

Military Expectations
(based on training, doctrine, tradition etc.)

Cultural Expectations
(based on social values, cultural morals, national pride)

After Pigeau and McCann (2000, 2006)
INTENT SHARING

Explicit Intent

Externalization (Implicit made Explicit)

Implicit Intent

Socialization (Training)

Internalization (unconsciously learned)

Dialogue (Exchange)

Explicit Intent

Externalization (Implicit made Explicit)

Implicit Intent
OPERATIONS INTENT AND EFFECTS MODEL

Decision Making
Decision Making Models

The Dynamic OODA loop (DOODA loop)

John Boyd’s OODA Loop

Processes
MDMP
GOP
IDC2
PUT
SITUATION AWARENESS

Task/System Factors

Individual Factors

Fig. 1. JDL data fusion model (1999 revision).
SITUATION AWARENESS

Transitory Awareness (TA)

Homogenous - heterogeneous information sources and representations

Smaller time span, command span, area of interest etc. Larger

What are they doing?
What will they do?
Who is there?
What do they want?

Local Awareness (LA)

What are they doing?
What will they do?
Who is there?
What do they want?

Global Awareness (GA)

What are they doing?
What will they do?

SAAB
Intent
Develops
Describes
Guides
End State

Initial State
Execution
Outcome

DM - Decision Making Process

Initial State
Sequence
Key Decisions
Constraints
Mission / Goal
Antigoals
End State

DM – Decision Making Process

Actions

State
OPERATIONS INTENT AND EFFECTS MODEL

OPERATIONS

INTENT

AND

EFFECTS

MODEL

DM

Orders

Describes

Actions

Causes

Effects

Move towards

End State

Initial State

Perceived by

Perceives

Produced by

Described by

Caused by

Produced by

Perceived by

Perceived by

Perceived by

Perceived by

Perceived by
Win the War

- Destroy will of Enemy
  - Acceleration of straggler count
  - Drop Intel
  - Carpet Bomb

- Halt Second Echelon
  - Traffic Density
  - Units in Bivouac
  - Prevent Crossing
    - River Clear
    - Deny Access

- Destroy Bridge 1
  - Attack with Bn1

- Destroy Bridge 2
  - Attack with Bn1

- Destroy Fuel Reserve
  - Isolate the Battle Field
  - Air Assault

- End-State
  - Effect
  - Mechanism
  - Indicator
  - Action
Credible TaskForce (TF) Freedom of movement and action of own forces ensured

Force Protection established

External support of ISAF established

Movements of others in area controlled

Local support for ISAF/ITU established

Narcotics eliminated

Physical insurgency capability of OMF eliminated

ANP operational

Temporal basic aid provided

Usable and productive available land established

NDS operational

ANA operational

ISAF - International Security Assistance Force
TFU – Task Force Uruzgan
OMF – Opposing Military Force
ANP – Afghanistan National Police
NDS – National Directorate of Security
ANA – Afghanistan National Army
OPERATIONS INTENT AND EFFECTS MODEL
Five Paragraph Order

**Situation**
- Enemy Forces
- Recent Actions
- Current Situation
- Expected Actions

**Mission**
- Own Forces

**Execution**
- Commander’s Intent
- Concept of the Operation
- Task to Maneuver Units

**Service Support**

**Command and Signal**

**OPORD**
OPERATIONS INTENT AND EFFECTS MODEL

DM – Decision Making Process
The OIEM model is a general and high-level description of C2 information constituents, their relations and causality in the view of an organizational planning context.
2007 BLACK-CACTUS C4I-Center ↔ SAAB

Model

Formalization

Robotics (119 Schade)
Grammar (083 Poteet)
C-BML (117 Heffner)
C-BML SDL (122 Heffner)

Implementation

C2-SIM SBML (021 Pullen)
C2-SIM CBMS (121 Diallo)
Cyber (111 Machado)
Robotics (119 Schade)

2006 Hieb and Schade
NMSG-048, NMSG-085

SISO 2004 →
Systems enabled for MSDL / C-BML by SBML/WISE

National Protocol

C2 mapping

C-BML

Sim mapping

Logging
Filtering
Tuning
Security
SBML

Robotic mapping

National

MIP
NFFI
LINK

9LandBMS
SitawareHQ
Rapid3D
Cyber

HLA
DIS
TENA

SWORD
VBS2
StealBeast
BattleTEK