# NAVAL POSTGRADUATE SCHOOL
# Monterey, California

# THESIS

**BUSINESS ARCHITECTURE MODEL FOR NETWORK CENTRIC SURFACE COMBATANT LAND ATTACK WARFARE**

by

William K. Shafley III

September 2001

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Land attack is a major mission area for the surface navy in the coming years. High levels of complexity characterize the land attack environment of 2015. The purpose of this research is to generate an understanding of the warfare architecture the land attack C4ISR-T systems will support. The *Business Architecture Model for Network Centric Surface Combatant Land Attack Warfare* depicts a networked resource structure of sensor, weapons, and decision makers that are transformed in a value added engagement process to achieve land attack goals. This structure was developed using the Eriksson-Penker Business Extensions Tool-Kit for the Unified Modeling Language (UML). The Eriksson-Penker Business View comprises the Business Vision, the Business Structure, the Business Process, and the Business Behavior. The *Business Model for Network Centric Surface Combatant Land Attack Warfare* uses this structure to view the land attack warfare architecture in terms of goals and problems, resources, processes and events, and system wide behavior.

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**BUSINESS ARCHITECTURE MODEL FOR NETWORK CENTRIC SURFACE COMBATANT LAND ATTACK WARFARE**


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Submitted in partial fulfillment of the requirements for the degree of

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from the

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# ABSTRACT

Land attack is a major mission area for the surface navy in the coming years. High levels of complexity characterize the land attack environment of 2015. The purpose of this research is to generate an understanding of the warfare architecture the land attack C4ISR-T systems will support. The *Business Architecture Model for Network Centric Surface Combatant Land Attack Warfare* depicts a networked resource structure of sensor, weapons, and decision makers that are transformed in a value added engagement process to achieve land attack goals. This structure was developed using the Eriksson-Penker Business Extensions Tool Kit for the Unified Modeling Language (UML). The Eriksson-Penker Business View comprises the Business Vision, the Business Structure, the Business Process, and the Business Behavior. The *Business Model for Network Centric Surface Combatant Land Attack Warfare* uses this structure to view the land attack warfare architecture in terms of goals and problems, resources, processes and events, and system wide behavior.

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# I. INTRODUCTION

## A. BACKGROUND

The United States military stands at the brink of a revolution in military affairs brought about by the speed and complexity of the information age. Documents such as *Joint Vision 2020* have crafted a vision of 21st-century warfare that incorporates precision engagement, dominant maneuver, full-spectrum protection, and focused logistics. This vision is made possible by a global information grid supporting the war fighter with timely, relevant, and secure information to enable a fully networked force of sensors, weapons, and decision makers.

For the United States Navy and Marine Corps, the mission of providing sovereign power forward remains a vital tool in the conduct of the nation's foreign policy. *Forward… from the Sea* and *Operational Maneuver from the Sea* (OMFTS) describe the roles and missions of the nation's sea-based forces. The Navy's key responsibilities in the "…post-Cold War environment are to influence events ashore by peacetime forward presence, by direct power projection, by ensuring access to the littorals for joint expeditionary forces, and by actively supporting those forces in crisis and in war." (SWM, May/Jun 2000, p. 5) *OMFTS* defines a vision for operations of Marine Corps units applying maneuver warfare concepts to joint operations in the littoral environment. "…[S]ea-based Marine Air-Ground Task Forces (MAGTFs) [will] bypass key centers of resistance by using the sea as maneuver space to move rapidly against operational objectives, by keeping the enemy off balance by maintaining a high operational tempo." (SWM, May/Jun 2000, p. 5). While the Navy and Marine Corps will continue to conduct prompt and sustained combat operations at sea, the forces that put to sea in 2015 will bear little resemblance in terms of equipment, speed, and agility to those ships, sailors, and marines on deployment today.

The Surface Warfare Vision for 2015 and beyond encompasses the traditional roles of naval action: air, surface, and undersea warfare. Maritime Dominance forms the foundation for the entry into the 21st-century joint battle space. It is a condition achieved by an unequalled capability to command the seas and project power ashore. Two mission areas, land attack and theater air dominance, enable its achievement. Maritime Dominance demands a robust and joint-interoperable command, control, communications, computer, intelligence, surveillance, and targeting (C4ISR-T) system. A C4ISR-T system is a tool used by commanders in conducting command and control to provide data and information in many forms with differing degrees of latency to various units allowing them to sense, to decide, and to act. It is an information system designed to provide commanders and operators with relevant data and information to conduct their missions.

Land attack borrows much from the traditions of sea combat. The complexities it brings to the battle space require a detailed examination of the processes involved to determine the requirements to be placed upon new C4ISR-T systems under development. Land attack warfare conducted using networks of sensors, weapons, and decision makers provides a method to conduct command and control in complex environments. Network centric land attack requires a C4ISR-T system that integrates sensors, weapons, and decision makers in an operating environment and provides system users the ability to participate at the strategic, operational, and tactical levels of conflict.

## B. METHODOLOGY

Architecture makes it possible to understand the structure being built. Architecting an information system begins with an understanding of the business the system supports. By basing architecture on a common business model, several advantages are achieved:

- Information systems become an integral part of the overall business, supporting the business and enhancing the work and the results.
- Information systems integrate easily with each other and can share or exchange information.
- Information systems can be updated and modified as changes to the business model are promulgated. (Eriksson and Penker, 15)

In *Business Modeling with UML-Business Patterns at Work*, Hans-Erik Eriksson and Magnus Penker describe a business using four broad concepts:

- Resources - The objects within the business such as people, material, information, or products that are used or produced in the business.

- Processes - The activities performed within the business that changes the state of business resources.
- Goals - The purpose of the business or the outcome the business as a whole is trying to achieve.
- Rules - Statements that define or constrain some aspect of the business and represent business knowledge.

These four business concepts can be represented in a model that shows their interrelationship. The model depicts how the business processes achieve goals through the use of resources and rules. The C4ISR-T system architecture necessary to support land attack warfare requires an understanding of the business model it supports. This model is created using the Eriksson-Penker Business Extensions of the Unified Modeling Language (UML). The Eriksson-Penker extensions comprise four views of the business:

**The Business Vision**: A view that describes a goals structure for the company and illustrates problems that must be solved to reach those goals.

**The Business Structure**: A view that depicts the structure among the resources in the business.

**The Business Process**: A view that represents the activities and values created in the business and illustrates the interaction between processes and resources to achieve the goal of each process.

**The Business Behavior**: A view that shows the behavior of each important resource process in the business model.

The Land Attack Business Architecture is developed using these views. Each view is examined as models in the following chapters. Methods specific to each model are indicated in their corresponding chapters. Each chapter explains the model in terms of its relationship to the Unified Modeling Language and includes a description of the objects and classes. The models are then applied to the land attack mission area. The specific information regarding land attack warfare for all four views is gathered from the *Concept of Operations for Surface Combatant Land Attack Warfare 2005-2015* (CONOPS). The CONOPS was published in February 2001 as a draft publication to solicit dialogue on its content from users and contractors. Appendices for each model include the UML diagrams and their explanations.

## C. RESEARCH QUESTION

What is the business architecture for land attack warfare using the Eriksson-Penker Business Views and their UML Extensions?

## D. CHAPTER ORGANIZATION

This thesis is presented in four chapters, each with a corresponding appendix. The four chapters cover each of the Eriksson-Penker Business Views. The corresponding UML diagrams are found in each appendix. Conclusions and summary are located at the end of the Business Behavior View and prior to the Appendices.

# II. BUSINESS VISION VIEW

## A. INTRODUCTION

A land attack C4ISR-T system integrates sensor, decision-maker, and weapon nodes in the operating environment. The development of land attack C4ISR-T systems requires not only an understanding of this environment but also the factors that affect it. Organization, technology, and doctrine shape the environment. Describing its complexities requires frequent changes in perspective. The Business Vision view relates these considerations in terms of land attack business goals and their associated problems.

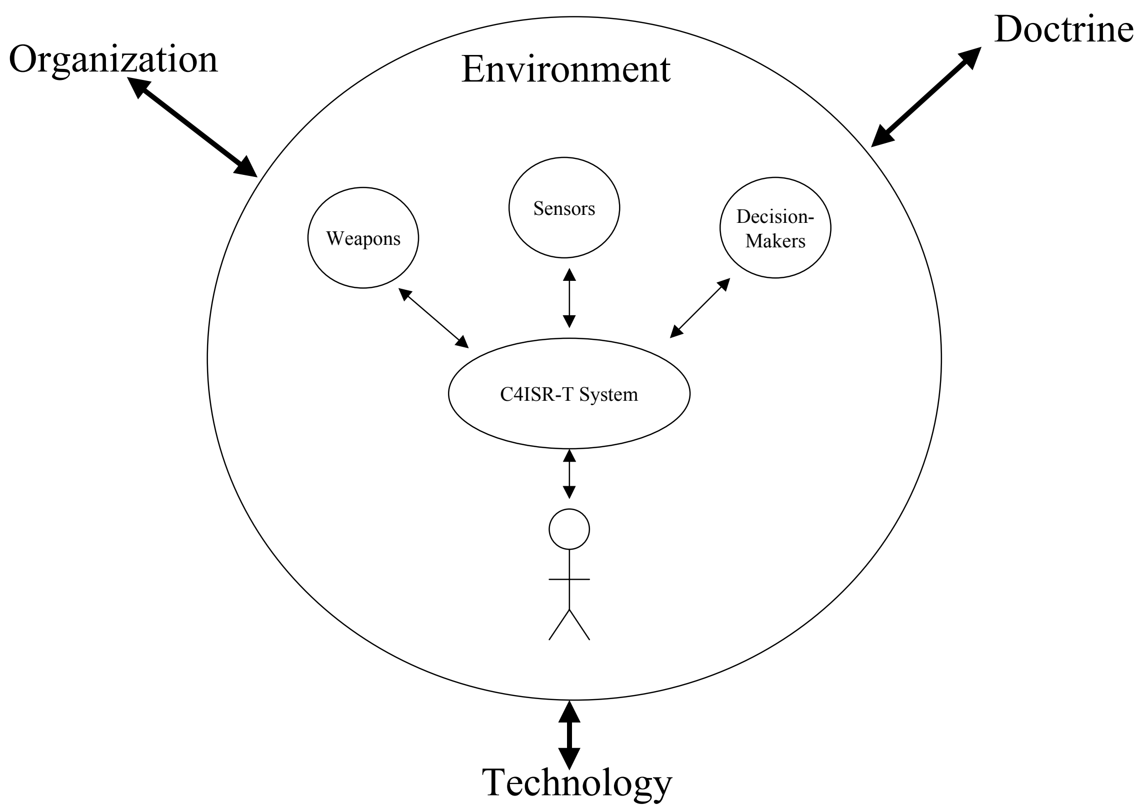


Figure (1-1) - The Land Attack Environment

The context for the application of the goal/problem model is the *Surface Combatant Land Attack Concept of Operations: Roles, Missions, and Employment Considerations*. The goal/problem model describes the primary business goals and relates them to specific problems showing constraints in their achievement. With the problems determined in the goal/problem model, they are also discussed in terms of their description, causes, prerequisites for solving them, and actions necessary to begin the process of providing proposed solutions.

### 1. Goal Problem Model Description

A goal/problem model is a UML object diagram depicting objects and their relationships. The goal/problem diagram breaks down high-level goals (super-goals) into sub-goals. Objects in this diagram demonstrate the dependencies between goals, the relationships between them, and the problems associated with achieving them. (Eriksson and Penker, 99). The goal/problem model depicts a specific goal as an object of the goal class. Super-goals are completely or partially broken down into sub-goals. The goal/problem model also describes the obstacles to achieving the business goal in the form of problems. Problems are temporary, in that they can be solved once and for all, or permanent, in that they can only be mitigated. Action plans are developed for problems in the form of causes, actions to solve, prerequisites for those actions, and processes required. A more detailed description and application of the goal/problem model are found in Appendix A.

## B. LAND ATTACK GOAL-PROBLEM MODEL

### 1. Goal Identification

*The Surface Combatant Land Attack Concept of Operations: Roles, Missions, and Employment Considerations* provides the desired goals for land attack warfare. The overarching goal is an "integrated employment of available sensors, weapons, and joint and coalition forces for projecting combat power into and on the ground portion of the battle space to protect vital national interests and achieve national and military objectives." (CONOPS, 1-1) Achieving this goal requires a fully integrated land attack capability. An integrated land attack capability allows for "sensor to weapons on-target" timeline for time critical targets and near-real time battle space deconfliction. Commanding officers must have situational awareness of a multi-warfare tactical picture and control over ship's resources in the operating area.

The integrated land attack capability requires commanding officers to execute land attack missions at all levels of conflict: strategic, operational, and tactical. Missions are conducted at the lowest echelon possible in the chain of command to achieve simplicity in execution. An integrated land attack capability provides the joint force commander a sea-based force considered the primary means to engage the adversary. The force should be offensive and integrated in a network-centric architecture, providing the commander with dynamically allocated firepower. Appendix A provides more details and description of the Land Attack Goal Structure.

### 2. Problem Identification

There are three problems facing associated with achieving a fully integrated land attack capability:

- The level of environmental complexity must be determined.
- The land attack organization is not structured to operate efficiently in the complex land attack environment.
- Platform-centric doctrine does not provide the flexibility and speed of command required to operate in the complex land attack environment.

VADM Arthur Cebrowski, former President of the Naval War College, and Dr. John Garstka have provided a model that aids in identifying environmental complexities. The model proposes a relationship between the environment and the factors that interact with it: organization, doctrine, and technology. (Figure 1-2) Technology, in this case consisting of weapons, ships, sensors, or networks, forms the base of the triangle. On one side is doctrine, such as rules of engagement and commander's intent, which describe the rules and constraints affecting the use of technology. Organization, which determines how technology is used, is on the third side. This model is used to provide the actions, prerequisites, and processes required in solving the problems associated with achieving an integrated land attack capability.

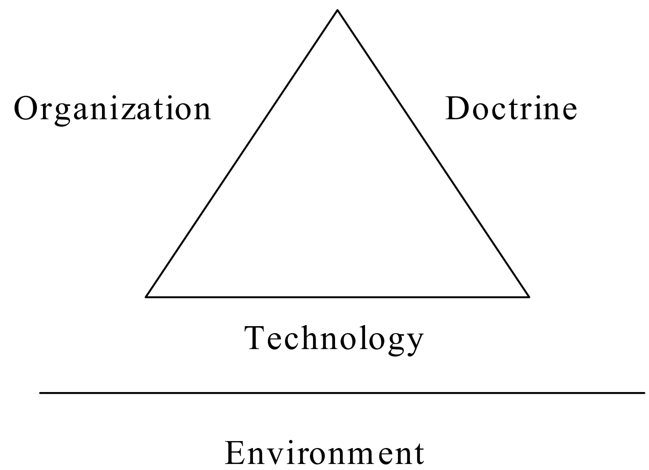


Figure (1-2) – Cebrowski and Garstka Model (From, C.R. Jones, Class Notes, CC3000)

The following sections identify environmental complexity and contain a discussion on doctrine and organizational solutions. The problem models and descriptions can be found in Appendix A.

***a. Three Levels of Environmental Complexity***

The integrated land attack capability depends on managing the land attack environment. Managing the land attack environment requires an understanding of where the complexities exist. Three views describe the environmental complexities. An integrated land attack capability is achieved in the context of an increasingly complicated geopolitical situation. The physical operating environment and the tasks associated with conducting land attack (force protection, deconfliction, and engaging targets) introduce more complexity. Advances in technology affect complexity at the unit level.

(1) A Macro View. The macro-environment is the geopolitical system affecting future conflict. The information age is characterized by invigorated competition, lowered barriers of entry into the global market, and the elimination, or reduction, in the competitive advantage most countries and businesses have enjoyed for many years. (Alberts, 45) These developments have given rise to a more robust global economy. The thaw of the Cold War and the fall of the Soviet Union in 1991 have drastically affected the world scene in terms of security. The bipolar power struggle of the Cold War has given way to managing global interdependencies between nations. These complexities involved at the geopolitical level create land attack scenarios where technical and doctrinal interoperability with allied forces are important.

(2) The Operating Environment. Post Cold War conflict has placed the Navy in the littoral regions of the world. From the Adriatic Sea to the Persian Gulf, the Navy's focus from blue water surface- to -surface and surface-to-air engagements against the Soviet Navy has migrated to the capability to strike land-based targets from the sea. These changes in physical operating environments and missions have brought new challenges. Strike missions are conducted from the decks of aircraft carriers and from ship-launched cruise missiles. These missions require higher levels of coordination between ground and air units in order to deconflict airspace and accurately engage targets. With sea-based units operating in proximity to the land-sea interface, the threat of shore launched anti-ship missiles and surface-to-air missile batteries is increased. Complexity in this area of the environment requires that decisions be made rapidly and with respect to changing operational and tactical environments.

(3) The User Environment. The user environment is changing as well. The use of information technology is affecting the way individual sailors and marines conduct their tasks. Experiments such as Smart Ship and Urban Warrior have introduced information technologies at the unit level to demonstrate how the availability of information affects how missions are conducted. In the case of the Smart Ship, crew size was reduced and processes reengineered to reflect the use of technology. Successes with Smart Ship have paved the way for new ship construction plans with crew sizes reduced to one-third that of today's ships.

The degree and persistence of these complexities point to the need to examine the organizational structures and doctrine that support land attack.

***b. Organizational Mismatch and Strategies for Change***

"…[T]he most important thing leaders can help their organizations to do, because the conditions under which businesses and governments are functioning today are more turbulent, more chaotic, [and] more challenging than ever…." is to master change. (Kanter, 71) Effective command and control has two characteristics: unity of command and simplicity in execution. Unity of command requires organizational cohesiveness, and simplicity in execution requires clear and uncomplicated plans. Achieving these two characteristics is to master the changing environments in which decision makers operate.

Many themes from the corporate and academic communities exist that can help achieve organizational cohesiveness and simplicity in execution. Figure (1-3), a new convention by Jansen (2001) based upon Mintzberg (1993), depicts a shift in organizational structure in the 21$^{st}$-century military as a result of increasingly complex environments. The graph shows how environmental uncertainty is affected by the amount of change in the environment, its hostility, and equivocality. Increases or decreases in environmental uncertainty affect the way an organization coordinates its efforts. These coordination efforts differ with the type of the organizational structure in use.

**Shift in Organizational Configuration for Modal DoD Organizations as they Move through the RMA**

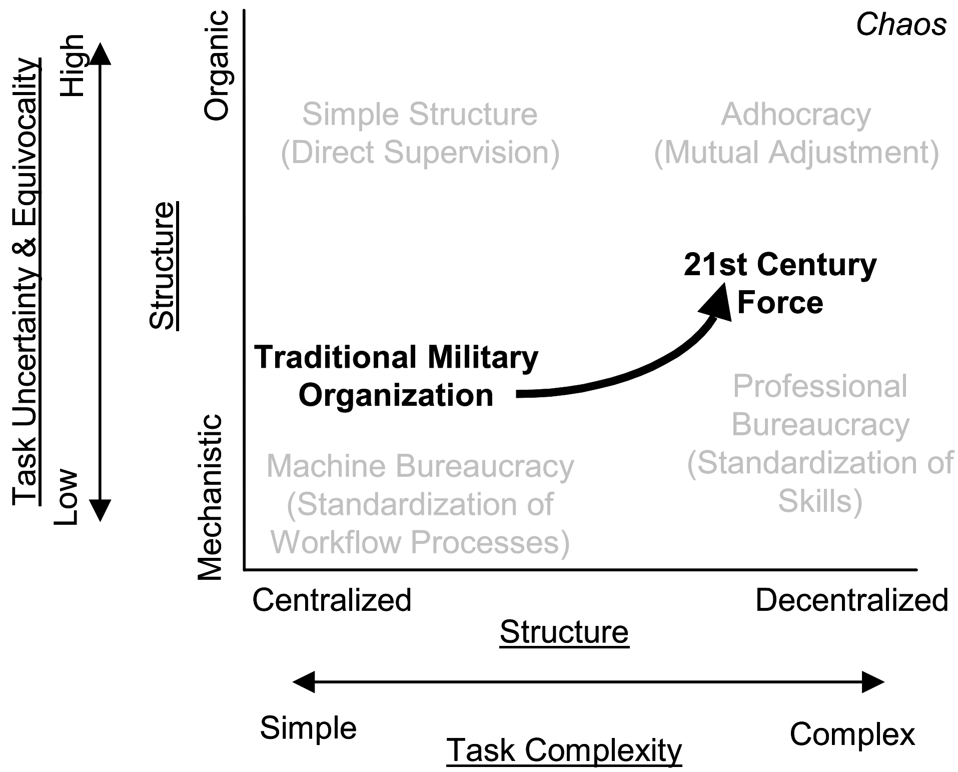


Figure (1-3) - Shift in Organizational Configuration for Modal Organizations as they Move Through the RMA (From Jansen 2001, based upon Mintzberg 1993)

A 21$^{st}$-century military force is classified as an organic organization, one characterized by low levels of organizational complexity and control mechanisms. Lower levels of organizational complexity and control mechanisms concentrate decision-making abilities, through constraints, at the appropriate level in the organization. These themes are further developed in the application of complex adaptive systems theory to organizational management.

Complex adaptive systems are characterized by an inherent self-organizing capability based upon the continual changes in the environment. Robert Maxfield, in his article "Complexity and Organizational Management", suggests that organizations are more successful when there are fewer operating principles and guidelines. Organizational structures serve as guidelines for interactions and relationships. Keeping pace with the ever-changing environment requires widely delegated decision-making authority coupled with short authority chains (Eisenhardt, 40).

Kathy Eisenhardt and Shona Brown, in *Competing on the Edge of Chaos*, build on Maxfield's conclusions. For an organization to keep pace with rapidly changing environments, it must be able to improvise effectively. Effective improvisation is characterized by small amounts of "…structure coupled with intense, real-time communication." (Eisenhardt, 45). She goes on to say, "these simple structures and extensive communication allow people to engage in much more complicated and adaptive behaviors…." (Eisenhardt, 45). Improvisational organizations have three common traits:

- Adaptive Culture: Managers expect change. They anticipate the need to iterate, backtrack, and adjust their actions.
- Semi-Structures: There are few formal structures. Processes rely on key structural points that are never violated. These structure points may be deadlines or priorities.
- Real-Time Communications: Communications are rampant throughout the organization, but, not without respect to boundaries or the task at hand. Communication is targeted on the task and focused in real-time. (Eisenhardt, 47)

Rosabeth Moss Kanter, in her article "Mastering Change," from the book *Learning Organizations*, edited by Sarita Chawla, also poses similar organizational traits. Kanter proposes four characteristics that provide sufficient leverage in coping with environmental complexity. Focused, fast, flexible, and friendly apply to organizational structure and guiding principles. Focused and fast describe organizational structure and communication. Focused organizations place decision-making capability in the proper places in the organization to facilitate speed. Fast organizations use streamlined semi-structures as guidelines for execution as a source of speed and adaptability. Flexible and friendly describe the adaptive culture in the organization. An adaptive culture uses flexibility in organizational structure to capitalize on changing environments. Flexibility and friendliness in organizational structure provide cohesiveness and simplicity in execution through using an adaptive culture to create structure and communication in response to changing environments.

***c. Doctrinal Mismatch - From Platform Centric to Network Centric***

A command-and-control approach requires a structure responsible for disseminating the commander's intent and resources. This structure serves as doctrine, or rules governing the way the business of warfare are conducted. A different approach, which mitigates the complexities of the land attack environment, modifies how warfare resources are organized. In a platform centric method of viewing resources, a platform has sensors and weapons. A decision-maker controls and consumes the limited platform resources in conducting processes in accordance with the commander's intent. In a network centric method of viewing resources, the network has resources capable of interacting to produce desired results. Decision makers control their use with commander's intent, but they have more flexibility in using resources to conduct processes. In the network centric system, each node logically connects to other nodes within the system. "The source of the increased power in a network-centric operation is derived in part from the content, quality, and timeliness of information flowing between the nodes in the network." (Alberts, 45 )

(1) Network Centric Land Attack. A generic land attack scenario provides some insight into the power of network centric warfare. The force assigned to conduct this land attack mission contains six amphibious ships, sixteen surface combatants, and a landing force comprising two regiments of marines (approximately 1500 personnel), fifteen assault vehicles, and twenty-five aircraft. Each portion of this force has organic sensors, weapons, and decision makers. As this large maneuvering force transitions ashore, surface forces must have a distributed means of sensing, deciding, and acting in order to keep pace with the complexity.

In a networked environment, sensors, decision makers, and weapons are linked together logically. Physical connections exist on the platform. Target information enters the network through the sensors in the form of raw data. The decision makers based upon the command and control inputs being received collectively evaluate the target data. Changes in the situation are rapidly disseminated among decision makers, and engagements are conducted using linked weapons. The linkage adds flexibility in terms of engagements, sensing, and decision-making. Figure (1-4) represents the networked system.

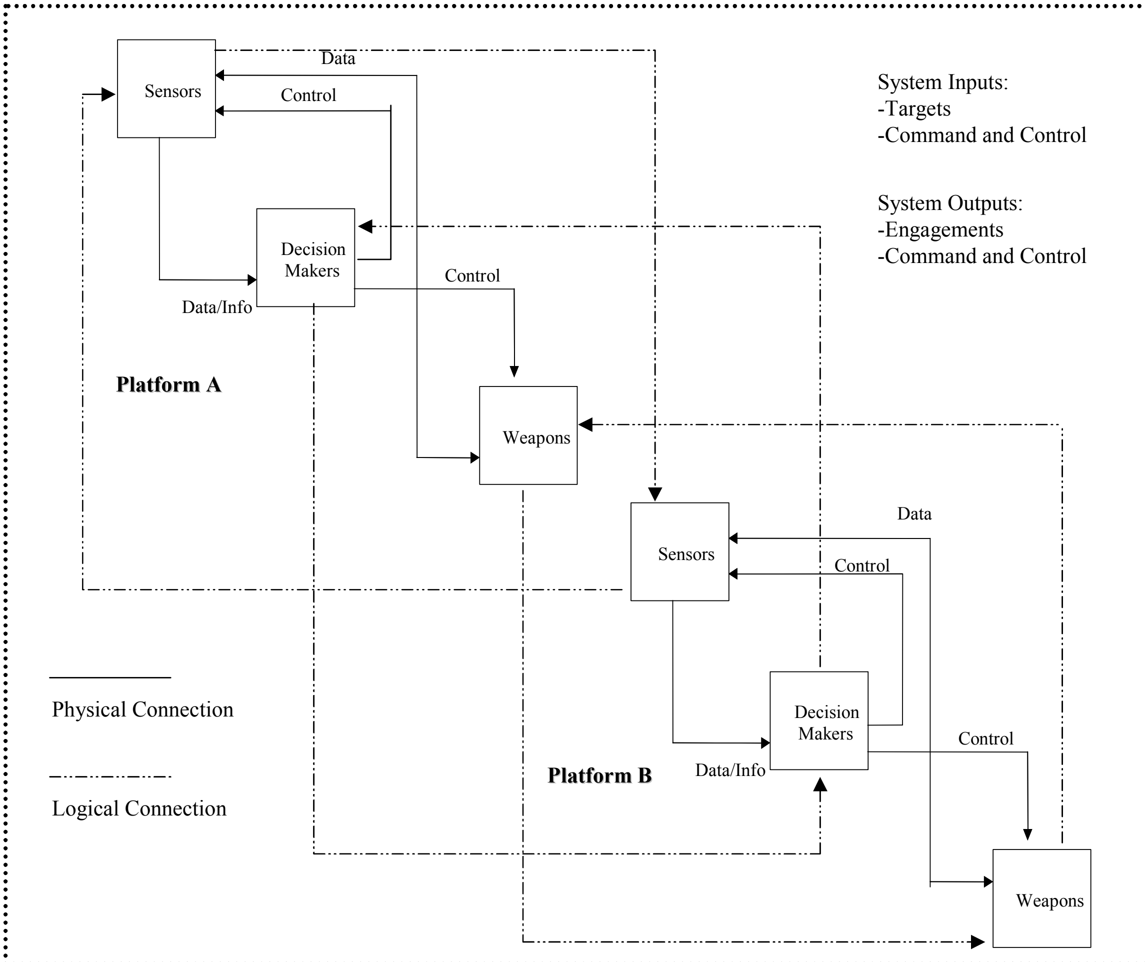


Figure (1-4) - Networked System- (After David Alberts, Fredrick Stein, and John Garstka September 1999)

## C. SUMMARY

A fully integrated land attack capability that can project combat power in support of national and military objectives is the goal of the land attack mission area. Land attack will be conducted in a rapidly changing environment, in support of maneuvering forces ashore or against time-critical strategic, operational, or tactical targets. This requires an evolution of fragmented sensors, weapons, intelligence, and command-and-control assets into a seamless architecture that allows a properly sized force to execute land attack missions at all levels of conflict.

Technical, organizational, and doctrinal problems exist that must be overcome to achieve this goal. While technology plays a major role in the evolution of the integrated land attack capability, it is only part of the solution. Organizational and doctrinal issues must be understood in terms of the complexities of the operating environments and must evolve with the technological solutions.

"Processes show the activities required to achieve explicit goals along with their relationships with the resources participating in the process." (Eriksson and Penker 105) In the next chapter, the structure of the land attack resources is examined. Key business information and the structure of the organization are modeled to provide a complete package of resources for consumption and transformation in the execution of the business process.

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# III. BUSINESS STRUCTURE VIEW

## A. INTRODUCTION

The Eriksson-Penker business extension tools model the business architecture using four views: The Business Vision, the Business Structure, the Business Process, and the Business Behavior. In the last chapter, the business vision was presented in terms of the land attack goals and associated problems. Processes consume and transform resources to achieve business goals. The business structure view focuses on how these resources are organized.

The Eriksson-Penker Business Structure view contains three models: a resource model, an information model, and an organization model. The Business Structure view uses UML class diagrams to depict the resources needed to conduct the core business processes. "…[T]raditional organizational charts and descriptions of the products and services …the company provides, are the basis for the Business Structure view." (Eriksson and Penker, 118)

The resource model depicts the inner structure of the resources, which form the land attack products and services. The resource model is structured in a manner that divides land attack resources into classes: sensors, decision makers, and weapons. The Business Structure view also models the information used during land attack engagements. This resource is modeled using the following classes: planning, targeting, coordinating, deconflicting, executing, and assessing. The organization is modeled last. "The basic functions of an organizational model are to show the allocation of resources, the reporting methods, task assignments, and the way the [organization] is managed." (Eriksson and Penker, 122). The land attack organizational structure is modeled using the following classes: strategic, operational, and tactical. These models are found in Appendix B.

### 1. Land Attack Missions and Roles

Land attack warfare consists of two missions, Naval Surface Fire Support (NSFS) and Naval Surface Strike (NSS). The NSS mission involves attacking strategic and or operational targets with precision guided munitions, such as the Tomahawk Land Attack

Missile (TLAM). The NSFS mission encompasses the use of naval gunfire in support of a ground combat force.

Naval Surface Fire Support (NSFS) provides fires to support maneuvering forces from naval guns, missiles, and electronic warfare systems. In a supporting unit role, one or more NSFS units receive orders to fire individually at targets from a fire-support coordination agency or directly from a forward observer. In the controlling unit role, a NSFS unit directs and controls fires for multiple surface combatants. A controlling unit receives requests for fire from fire-support coordination agencies, processes them in accordance with the commander's intent and rules of engagement, and assigns one or more ships under its control to provide the support.

Naval Surface Strike (NSS) is the destruction or neutralization of enemy targets through the use of conventional weapons provided by surface combatants. Ships engage targets at all levels of conflict. Engagements are conducted independently of ground maneuver forces. In a single ship role, a NSS unit is responsible for planning, targeting, deconflicting, coordinating, executing, and assessing its own strike missions in accordance with commander's intent. A unit has the authority to determine which targets to engage, with what weapons, and to what degree to engage them. In the Multi-Ship role, a NSS unit must be able to conduct those duties explained above, as well as control and assign strike missions to other surface units operating in concert.

## B. LAND ATTACK BUSINESS STRUCTURE VIEWS

### 1. Land Attack Resource Model

The resource models are organized such that land attack resources are categorized in one of three classes: sensors, weapons, and decision makers. They are graphically represented in Appendix B. The classes translate into a network centric arrangement. The following land attack scenario, as developed by the CONOPS WIPT, provides a background for analyzing the resources:

> In 2015, the Straits of Hormuz have been closed. The United States chooses to respond to the situation unilaterally, through the use of an amphibious task force and its supporting units. To reopen the Straits of Hormuz, the US conducts an amphibious assault on the coast adjacent to the eastern side of the straits in order to clear out enemy coastal defenses

> and threats to shipping. An amphibious task force has been assigned to conduct the mission. Sixteen surface combatants, organized in four surface action groups comprised of four ships each will support it. The assault will be of Marine Expeditionary Force (MEF) size. It will be comprised of a regimental sized vertical assault in one area, and a regimental sized surface assault in another. The surface units are assigned fire support roles to support the assault.

#### *a. Decision Makers*

Three levels categorize decision makers: strategic, operational, and tactical. Decision-maker resources are classified in the same manner. Engaging targets can be time critical events. A timely response requires that decisions be made at appropriate levels of conflict. Decision-maker responsibilities vary with type of decision-maker. The decision-maker resources are focused on what is appropriately decided at each level.

Decision makers in the strategic class set commander's intent and generate rules of engagement. They are responsible for specifying the forces' mission, establishing target packages, and providing them to operational commanders in the form of simple, clear, and concise directives. The unified commander utilizes the Joint Force Commander and his/her staff to promulgate these directives. The Joint Force Commander has four specialized decision makers in the form of component commanders. They aid the Joint Force Commander with specific decisions regarding the employment of land, air, sea, and special operations forces. Intent and rules of engagement are issued to operational commanders, from these specialized decision makers, to use as guiding principles when planning the campaign.

Decision makers in the operational class use the mission, commander's intent, and rules of engagement and apply them to available resources. From the Straits of Hormuz scenario, a regimental-sized vertical and surface assault is conducted to forcibly reopen the sea passage. Three types of decision makers exist at the operational level: the Commander Amphibious Task Force (CATF), Commander Landing Force (CLF), and the Tomahawk Strike Coordinator (TSC). Rules and relationships exist between CATF and CLF about the types of decisions made during the amphibious assault timelines. Decisions are made about what time the amphibious assault will take place, the size, specialization, and order of the assault. The TSC deconflicts TLAM (Tomahawk Land Attack Missile) campaigns with the Joint Force Air Component Commander (JFACC) and provides advanced deconfliction of TLAM launch sequence plans among firing units. These decisions are made within the confines of the commander's intent and the clear, concise, and simple plans from the strategic decision making level. The operational commander issues orders to tactical units with more specific commander's intent and ROE.

Decision makers in the tactical class make decisions with specific time requirements. Ground force fire support requirements for supported units are gathered, prioritized, and assigned firing units. Decisions, such as which firing unit is in the best position to successfully complete the engagement, are made at the tactical level. Commanders of firing units, at sea and ashore, decide how to best configure sensors and batteries to deconflict local areas of fire and ensure proper rates of fire to achieve mission success. Commanders have teams of decision makers in their operations centers evaluating tactical data and making recommendations for action. Tactical decision makers observe their surroundings, orient themselves to their current situations, decide on proper courses of action, and execute the plans. Tactical decision makers operate rapidly using clear commander's intent to coordinate fires, coordinate friendly and neutral force movements, and engage the hostile forces,

***b. Sensors and Weapons***

An integrated land attack capability rests upon the ability to conduct precision engagements, properly scaled in terms of rate and type of fire. To conduct NSFS and NSS missions, the commander must have sensors available to search, detect, track, and classify targets of interest. Sensors available to decision makers range from shipboard radar to national space based reconnaissance assets. A sensor may be classified as one of three resources: surveillance, detection and tracking, or reconnaissance.

Decision makers must have the ability to use and provide data and information to these sensors. For example, when an at-sea unit is conducting NSS missions against time critical targets, decision makers have imagery of these targets from national space assets used in mission planning. The firing unit needs to augment this imagery with updated information prior to engaging it. The firing unit launches two Unmanned Aerial Vehicles (UAVs) and passes their control to special operations forces ashore. The UAVs send current target information including target type, size, direction of movement, and friendly forces in the area. The firing unit updates the target information in the target folder. It engages the target in accordance with commander's intent and rules of engagement with four rounds of Extended Range Guided Munitions (ERGMs) from its Advanced Gun Mount. With rounds complete, the special operations forces use the UAVs to conduct battle damage assessment (BDA). The special operations forces report primary and secondary explosions in the vicinity of the attack and confirm the target destroyed. The firing unit updates the target information with the imagery of the destroyed target and stands by to conduct further engagements.

(1) Weapons. In the Straits of Hormuz scenario, decision makers have numerous weapons available for use to ensure precision and scalability. Land Attack weapons fall into one of three categories: fires, maneuvering forces, and electronic warfare. Electronic warfare weapons are another method of destroying enemy targets asymmetrically. The classification of this work precludes their discussion.

Weapons are classified as fires and maneuvering forces. These are the primary weapon resources used by decision makers conducting land attack warfare. Freeing the Straits of Hormuz requires a combined regimental, vertical, and surface assault. The Marine Air, Ground, Task Force (MAGTF) conducts the assault from amphibious shipping from over the horizon. The maneuvering forces, Landing Craft Air Cushion (LCAC) and Advanced Amphibious Assault Vehicles (AAAV), carry Marines and their equipment ashore. Rotary wing aircraft, supported by fixed wing marine fighters, aide in transferring the Marines ashore. Ships and aircraft, in support of the maneuvering forces, provide fires as they proceed inland. Fires exist in many forms, from precision-guided munitions to gravity bombs, rockets, and mortars. Using their situational awareness of the battlespace, decision makers select the proper fires based upon type of target, proximity to friendly and neutral forces, and lethality. Additionally, decision makers must have visibility of all weapons resources in order to select those best suited for the missions at hand to ensure precision, lethality, and scalability.

### 2. Land Attack Information Model

The Eriksson-Penker UML Business Extensions Tool Kit "…creates models of strategically important information in the business." (Eriksson and Penker, 119). This information model depicts information in a class-object model (Shown in Appendix B.). Information can control actions taken by decision makers, as well as be controlled by decision makers during the execution of the engagement process. Knowing the types of information within the business model aids decision makers in designing information systems that leverage it in the most effective manner.

The land attack information model was compiled using the following considerations. A time-critical strike requires a great deal of information sharing. The *Network Centric Operations: Time Critical Strike CONOPS* lists the information-sharing requirements:

- The capacity to share information about targets and surrounding threats must be present in a format that will facilitate rapid decision-making.
- Updated surveillance and reconnaissance information and a common operating picture should be shared between echelons.
- Command and Control procedures and systems must be in place that allow for the execution of time-critical strike at the lowest feasible level, while providing simultaneous synchronization and deconfliction with other friendly forces.

The land attack missions and roles were examined to determine the most demanding information environments. In both missions, surface units must act in single and multiple ship roles. In NSS missions, a single surface combatant is required to plan, target, coordinate, deconflict, control, execute, and assess its fires. In NSFS mission, in a coordinating unit role, a unit receives requests for fire from fire-support coordination agencies. It processes the requests, in accordance with commander's intent and rules of engagement, and assigns one or more ships under its control to provide the requested fires.

Strategic and operational decision makers require data and information regarding the tactical situation so as to best prepare for future events, allocate resources, or issue updates and revisions to commander's intent and rules of engagement. Land attack information requirements are broken down into planning, targeting, deconflicting, coordinating, controlling, executing, and assessing categories. Each decision-maker uses information in these categories differently.

### 3. Land Attack Organization Model

The organizational structure model furthers the notion of strategic, operational, and tactical levels of conflict to model the land attack organization. It concentrates on organization as the means to distribute resources and decision-making authority in terms of commander's intent and rules of engagement. The organizational model is graphically depicted in Appendix B.

The operation to reclaim the Straits of Hormuz begins with the National Command Authority. The President of the United States, with the aide of the National Security Council and through the Secretary of Defense, exercises "…statutory authority, direction, and control over the [armed forces] and is responsible for the effective, efficient, and economical operation." (Overview of the National Security Structure, 1) The Chairman of the Joint Chiefs of Staff (CJCS) serves as a statutory advisor to the President as part of the National Security Council and is an intermediary between the unified commanders and the National Command Authority (NCA). The Goldwater-Nichols Act of 1986 defines the command authority for all combatant commanders. Unified combatant commanders have the authority to prescribe chains of command within their commands, organize commands and forces to carry out missions, and employ forces necessary to carry them out.

In the event of a conflict, such as the operation to free the Straits of Hormuz, USCENTCOM (United States Central Command) may elect to serve as the Joint Force Commander. The Joint Force Commander has subordinate staffs to integrate the various services. The Joint Force Commander's staff is organized into various component commanders: air component, land forces component, maritime component, and special operations component. Through the use of operational control (OPCON), the Joint Force Commander delegates to these component commanders the authority to organize the composition of subordinate forces, assign tasks, and designate objectives. These component commanders have the authority necessary to accomplish the mission. Separate forces operating within the unified commander's geographic area fall under the responsibility of the component commander. These operating forces are given OPCON by the component commander's to conduct particular aspects of the joint mission.

In the Straits of Hormuz scenario, the Naval Component Commander (NCC), Commander Task Force 50 (CTF 50), is given OPCON by the JFMCC, Commander Fifth Fleet (COMFIFTHFLEET), conducts the maritime portions of the mission. COMFIFTHFLEET grants OPCON to CTF 50, a commander amphibious task force (CATF), and a Commander Landing Force (CLF) to conduct the amphibious assault. The CTF 50, CATF, and CLF have resources at their disposal and utilize tactical control (TACON) in the execution of their operations. TACON is the "detailed and, usually, local direction and control of movements or maneuvers necessary to accomplish missions or tasks assigned." (Overview of the National Security Structure, 5).

The CTF 50, as a battle group (BG) commander has OPCON and TACON of assigned resources as well. Within the BG there exist various resources and command relationships. The Composite Warfare Commander's (CWC) structure organizes battle group forces. The CWC is responsible for assigning warfare area commanders and resource coordinators. A battle group has one commander for each warfare group: air, surface, undersea, and strike. Resource coordinators allot the use of common fleet resources such as fixed wing aircraft and helicopters. The CWC controls the operational environment by negation and modifying commander's intent and rules of engagement as the tactical situation changes. The BG commander may dispatch resources to CATF in conducting amphibious operations. For example, CATF can take OPCON of surface action groups (SAG) of two or more ships to conduct Naval Surface Fire Support or Naval Surface Strike Missions. Within the SAG individual Land Attack (LA) units, teams of personnel are conducting LA operations from their Combat Information Centers. The BG commander may additionally assign a Tomahawk Strike Coordinator (TSC). The TSC assigns Launch Area Coordinators (LAC) to specific launch points and to coordinate and to deconflict NSS Missions.

## C. SUMMARY

The Business Structure view serves as a method to analyze the resources used in the business process. The business process transforms resources to achieve business goals. In the Land Attack process, sensor, weapon, and decision-maker resources are used to conduct NSFS and NSS missions. This chapter has provided an analysis of the available resources structured in a manner that supports dynamically allocated firepower provided to commanders at the appropriate level of conflict with the decision-making ability to conduct them. In the next chapter, the land attack business processes are modeled using the Eriksson-Penker UML Business Extension Tool Kit. These views show the available resources and depict how they are transformed to achieve the business goals.

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# IV. BUSINESS PROCESS VIEW

## A. INTRODUCTION

The previous chapters proposed a resource structure that organized warfighting capability around sensor, weapon, and decision-maker resources. The next step is to examine the business of land attack in terms of events and processes. "A business process is a collection of activities that takes one or more kinds of inputs and creates an output that is of value to the customer." (Eriksson and Penker, 68) Using the Eriksson-Penker Business Extensions Tool Kit for the Unified Modeling Language (UML), the core land attack processes are examined in terms of those resource types and in relation to a set of business events.

Constructing the business process model begins with an introduction of the core land attack business process: the engagement. The "Call for Fire" is presented as its key business event. It "Call for Fire" is described in terms of decision points and rules sets that it imposes on the engagement processes. The engagement process is depicted in process diagrams, which include the resources involved in terms of input and output objects and those objects acting as supplies and controls in the process. Detailed descriptions of the processes and the event cycle are located in Appendix C.

## B. ERIKSSON-PENKER BUSINESS PROCESS VIEW

As previously stated, a business may be viewed in terms of its goals, resources, and organizational structure. The goals, resources, and organizational structure exist in order to accomplish work. The work of the business is understood in the business process. "The [business] processes show the activities that must be undertaken to achieve an explicit goal, along with their relationships with the resources participating in the process." (Eriksson and Penker, 105)

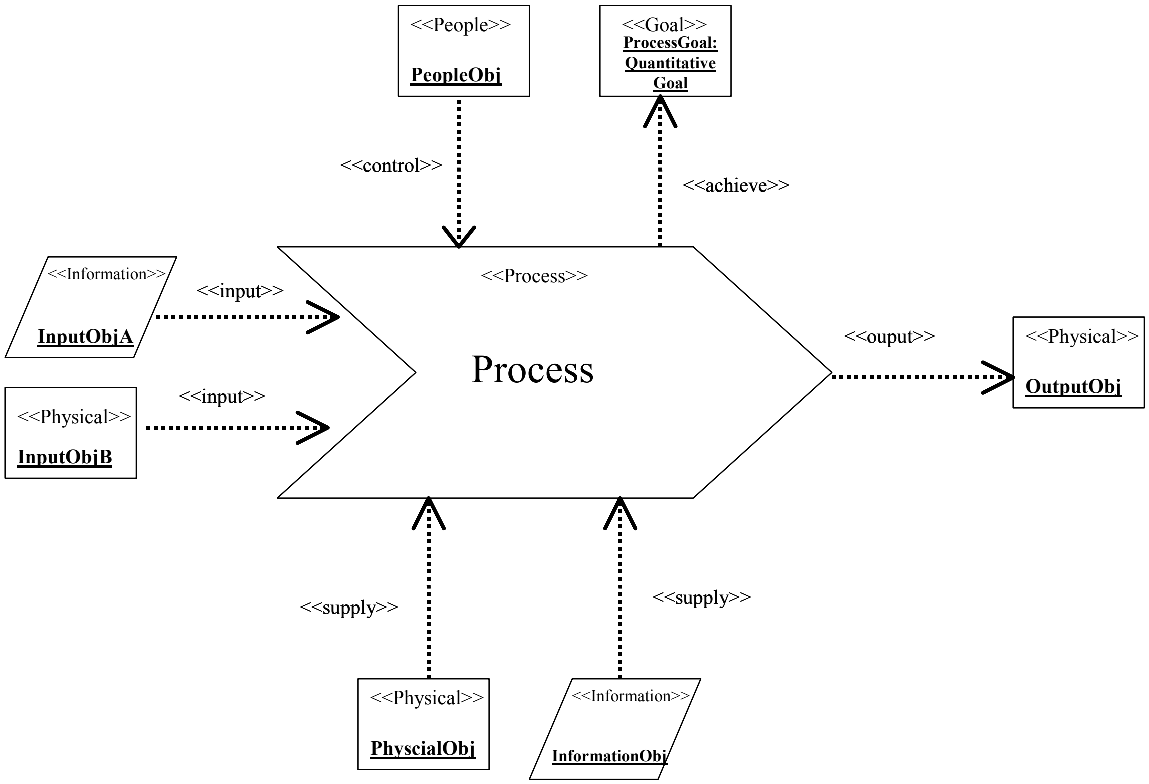


Figure (3-1) - Generic Process Activity Diagram (From Eriksson and Penker 2000)

The business process view is described using a UML activity diagram. The activity diagram is modified by the Eriksson-Penker Business Extensions to depict a set of stereotypes that define a process and its various resources. (Eriksson and Penker, 105) The process diagram (Figure 3-1) depicts the interaction between resources participating in the process. The process diagram shows five different types of objects. They are listed below with a brief discussion of each.

- **Goal Objects**: One or more goal objects are associated with each business process. The goal object will be achieved upon completion of the process.
- **Input Objects:** Objects that are either consumed or refined in the process. The input objects are resources compiled from the Business Structure view
- **Output Objects:** Objects that are produced by the process or exist as a result of the refinement of the input objects. The output objects are resources compiled from the Business Structure view.

- **<u>Supplying Objects:</u>** Objects that participate in the process but are not consumed or refined. The supplying objects are resources compiled from the Business Structure view.
- **<u>Controlling Objects:</u>** Objects that affect the execution of the process. The controlling objects are resources compiled from the Business Structure view.

A process may be broken down into sub-processes, and sub-processes into activities. For example, the process associated with changing a flat tire includes the sub-process of reading an owner's manual for instructions and the activity of opening the book and checking the table of contents for the proper page. Any process may be decomposed into large amounts of sub-processes and activities. A process is considered atomic when a sufficient level of detail has been reached for the process being examined. Continuing with the owner's manual example, the sub-process may be declared atomic at the "read the owner's manual" level.

The Eriksson-Penker business notation represents business events as classes and objects in a generalization hierarchy to depict their relationships. A business event may be classified as either sending or receiving. A sending business event is generated by a process and initiates another portion of the same process or a completely new process. A process waits for a "receive" business event before it begins the next activity. A receive business event may also be used to trigger a set of alternative processes, thus acting as a decision point.

## C. IDENTIFICATION OF LAND ATTACK CORE PROCESSES AND BUSINESS EVENTS

### 1. Development of the Engagement Process

The land attack business process model consists of two parts: the Land Attack Core Processes and the Land Attack Business Events. Identifying the key concepts associated with land attack business processes was accomplished by reviewing the *Surface Combatant Land Attack Concept of Operations: Roles, Missions, and Employment Considerations* and the *Network Centric Operations, Time Critical Strike Concept of Operations*.

The land attack core process is the "engagement." The "engagement" consists of four sub-processes: detect, decide, engage, and assess. The key land attack business event is the "Call for Fire." The "Call for Fire" business event consists of four decision points (explained in Appendix C) that answer the "Call for Fire" and impose associated rule sets on the "engagement" process. The baseline business process models and event structures were generated from descriptions of Naval Surface Fire Support and Naval Surface Strike listed in the previous chapters.

The principles of time-critical strike provide the basis for the land attack "engagement" process. The time-critical strike decision cycle provides a process for decision makers that may be used to engage time-critical targets. The decision cycle consists of four steps: detect, decide, engage, assess. They are explained in more detail below: (TCS CONOPS, 15-30)

- **Detect:** The process in which targets are investigated, validated, and nominated for engagement. The intent of the detection process is to rapidly identify the target as one that warrants response and then pass that information on in the decision process. The detect process includes six steps: cue, assess, task, collect, exploit, and nominate.
- **Decide:** In order to handle the number of potential targets that may be detected during any phase of joint operations, distributed decision making must be used to prioritize targets, select weapons, and ensure adequate synchronization and deconfliction occur. An engagement decision is the result of the "decide" process. The decide process consists of seven steps: prioritize, weapon-target-platform match, decide, coordinate and deconflict, update mission planning, weaponeering, and tasking.
- **Engage:** With the engagement decision made, the next step is to task the execution of the decision and plan for the assessment of the engagement. Execution can be conducted in three ways, depending on the type of target being engaged and the strategic, operational, or tactical situation involved. The three types of execution are: decentralized execution, update mission execution, and new mission execution. Assessment planning is expected to ensure that adequate intelligence, surveillance, and reconnaissance (ISR) resources are available to decision makers prior to execution in order to quickly and accurately assess the execution of the engagement decision.
- **Assess:** The assessment phase differs from the detection phase in time only, in that it occurs after the engagement has been executed. The assessment phase consists of the same five steps as the detection phase

### 2. Land Attack Core Processes and Business Events

The land attack core processes are viewed in terms of their relationship with the land attack business events. "A business event represents a record of a change in the business at a particular instance in time." (Eriksson and Penker, 74) The business processes are initiated, affected, or terminated by an instance of a business event.

#### *a. Land Attack Business Events*

The key business event associated with the land attack core processes is the "Call for Fire". A "Call for Fire" serves as the external event requiring certain actions (Eriksson and Penker, 74). The "Call for Fire" requires instances of sensor, decision maker, weapon, and information resources to produce the engagement. The business event cycle serves two purposes. First, it initiates a decision matrix. Second, it invokes business rules associated with the event, dictating how resources are used in the ensuing engagement process.

The "Call for Fire" business event cycle is negotiated through a series of decision points that describe how the "engagement" process unfolds. Once executed, decision points initiate sub-events and associated rule sets. The rule sets specify how the "engagement" process is executed. Figures 3.2 and 3.3 represent the cycle. The concave symbols depict sending events, and convex symbols depict receiving events.

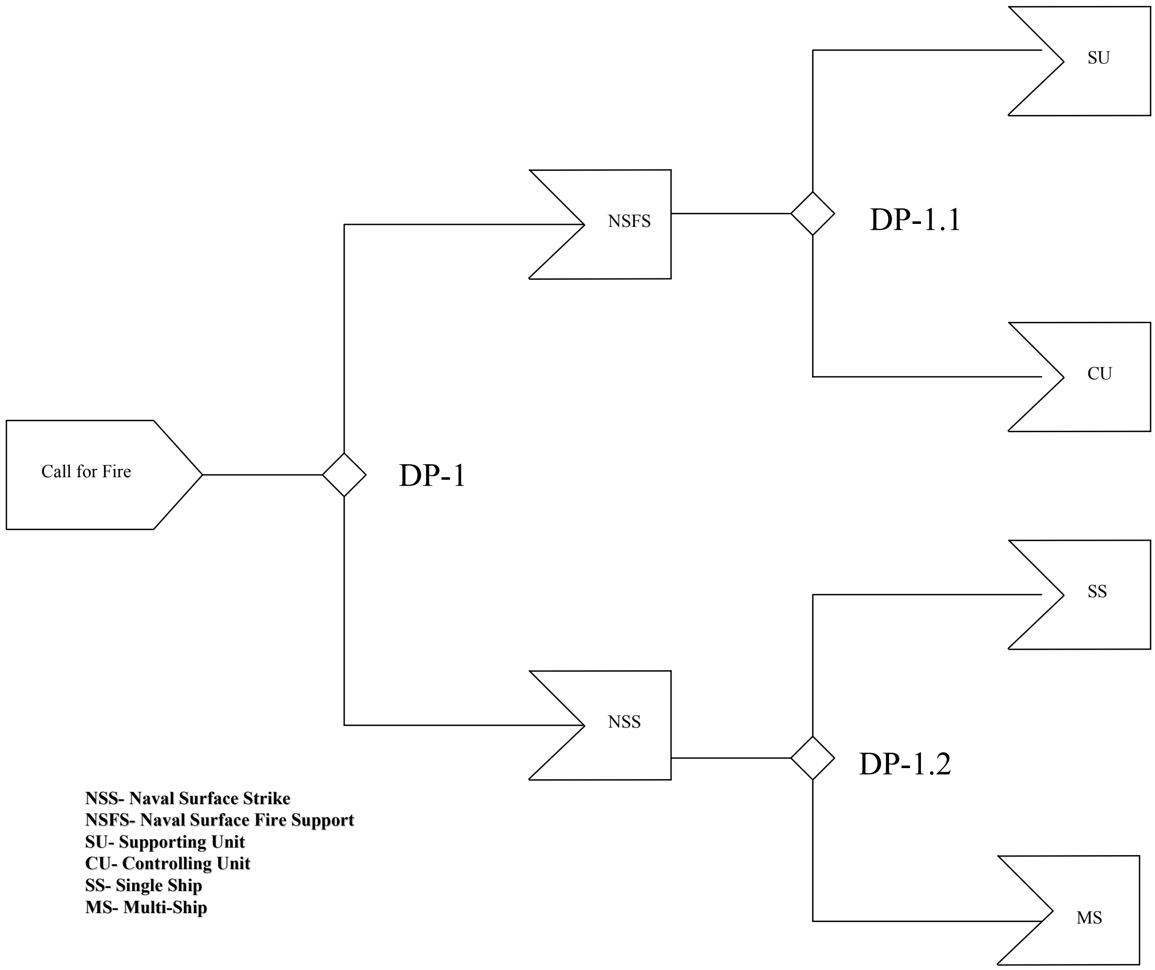


Figure (3-2) - "Call for Fire" Event Cycle (Part 1)

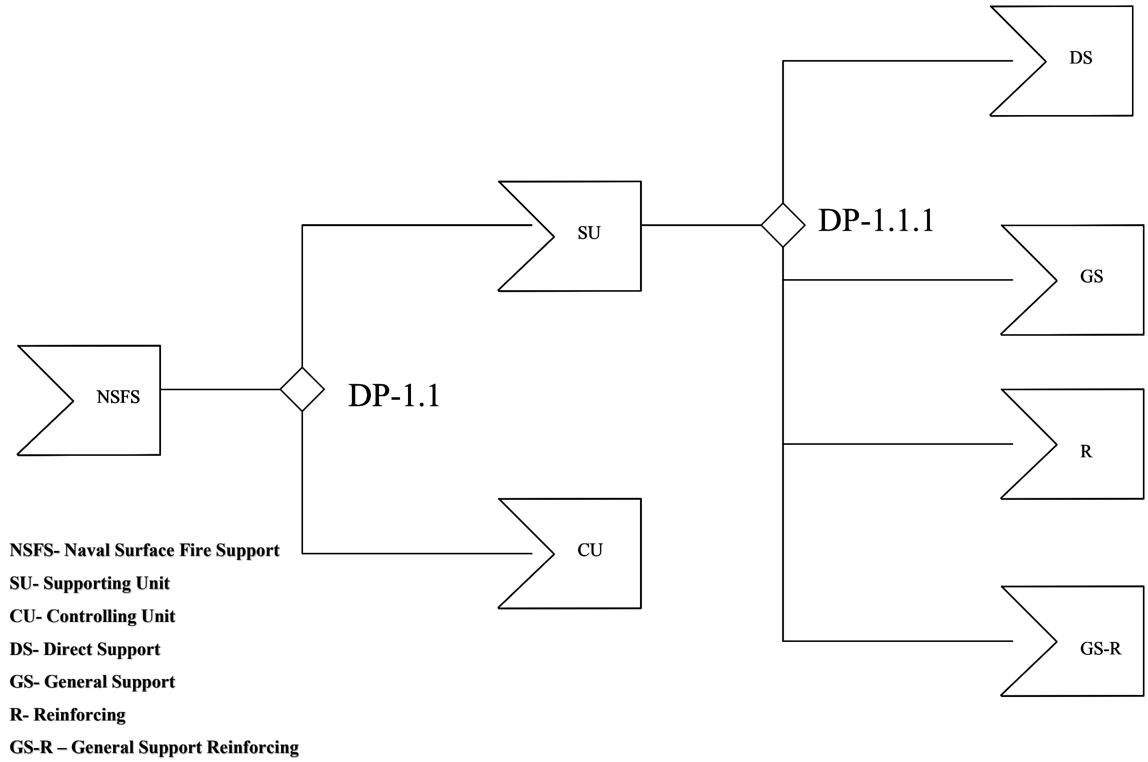


Figure (3-3) - "Call for Fire Event Cycle (Part 2)

The "Call for Fire" involves three decision points (Figure. 3-2). The first decision point differentiates the type of engagement. If the "Call for Fire" is in support of maneuvering forces, it is answered using the NSFS event and rule set. If the "Call for Fire" is independent of a maneuvering force, it is answered using the NSS event and rule set.

A "Call for Fire" answered using NSFS rules generates a controlling unit or a supporting unit event and associated rule sets. A description of the controlling unit and supporting unit concepts describes the rules. A controlling unit directs and controls the fires of multiple surface combatants. A controlling unit receives requests for fire support from fire support coordination agencies, processes the requests in accordance with commander's guidance, and assigns one or more ships under its control to provide the requested fires. A supporting unit provides fires in support of maneuvering forces ashore. One or more ships individually receive orders to fire from a fire support coordination agency of the supported unit or directly from a forward observer.

A "Call for Fire", using NSS rules, generates a single ship or a multi-ship event and associated rule sets. A single ship must be capable of planning, targeting, controlling, coordinating, deconflicting, executing, and assessing own-ship fires. A single unit receives mission orders, commander's guidance, and rules of engagement from higher authority, and with no higher-level on-scene commander or fires coordination element in the area of operation must execute the mission. As the coordinator of a multiple ship group, the single ship must be able to conduct strike missions as a single unit as well as control units in the execution of strike missions.

The final set of decision points exists when a unit is conducting NSFS (Figure 3-3). As a Supporting or Controlling Unit, it may be assigned additional roles, which determine the type of service the unit provides. In the Direct Support (DS) role, a unit provides close supporting fire to a specific unit. A platform operating in the General Support (GS) role provides support to the force as a whole. In the Reinforcing role (R), a fire support unit reinforces the fires of another unit who is in a DS role. A platform operating in a General Support-Reinforcing role (GS-R) provides general support fires to the force as a whole and reinforces the fires of the assigned direct support unit.

The decision points and rule sets are described in more detail in Appendix C.

### *b. Land Attack Core Business Process*

The core land attack business process is the "engagement." The engagement process consists of four sub-processes, each with associated activities. The four sub-processes are: detect, decide, engage, and assess. The "engagement" process is a value-added process that transforms unevaluated entities into destroyed targets. (Figure 3-4)

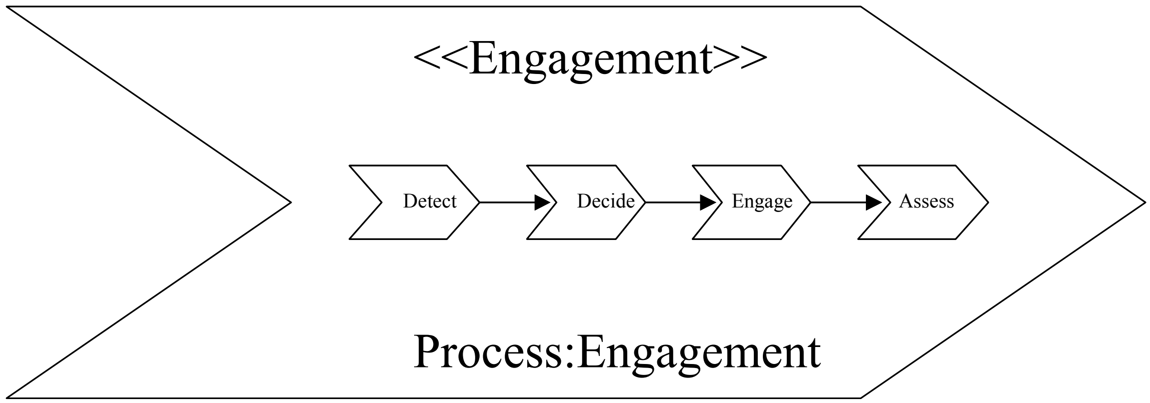


Figure (3-4) - Engagement Process Diagram with Sub-Processes

Developing the "engagement" process and its parts requires the introduction of a new resource named "target. " The target resource serves as the input to the engagement process. The engagement process uses sensors and weapon resources controlled by decision-maker resources. They transform the target from an undetected physical object (the input to the engagement) to an evaluated physical object that has been engaged with a weapon (the output of the engagement) (Figure 3.5).

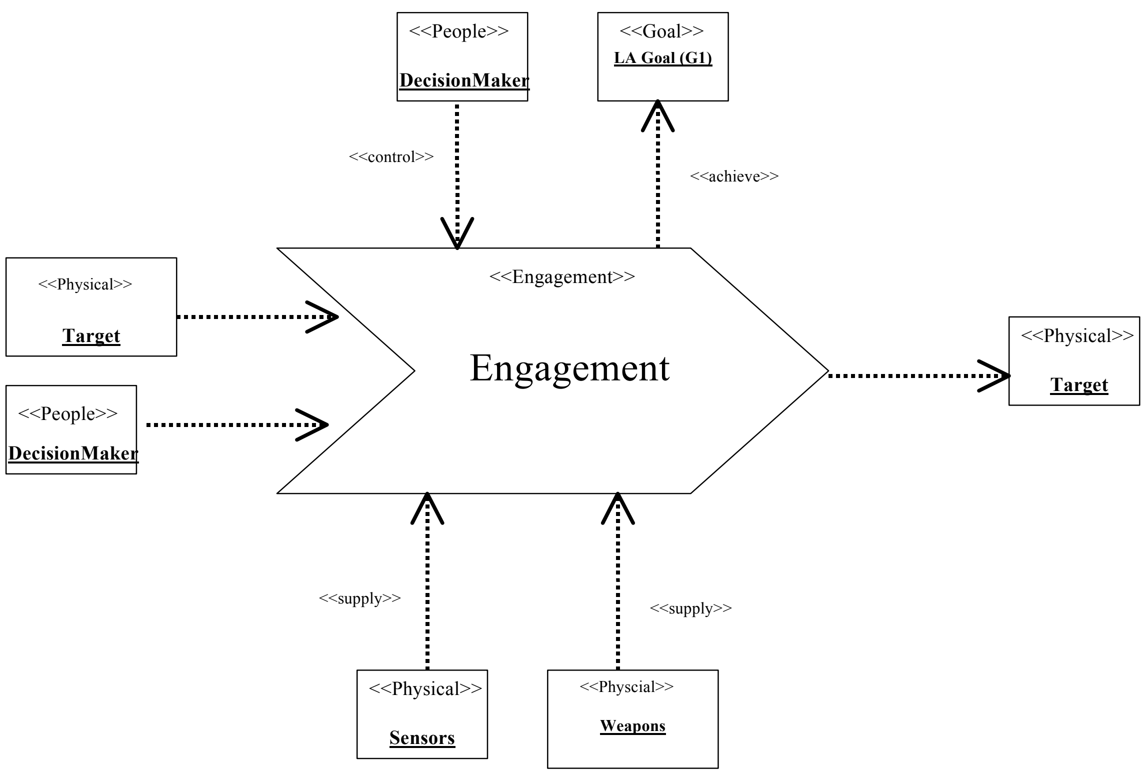


Figure (3-5) - Engagement Activity Diagram with Resources

Basic categories such as friendly, neutral, and enemy involve a value-adding process. A target is any physical entity with potential military, economic, or political importance to the commander. Targets may constitute key capabilities or centers of gravity and exist at all levels of conflict. For example, a potential target is an intelligence processing facility or tanks in the line of advancing infantry. Targets have no inherent strategic, operational, or tactical value until decision makers evaluate them.

For example, land attack decision makers value the location of country Red's intelligence processing stations. Satellite imagery of a group of buildings in an urban area is received and evaluated by intelligence analysts. The buildings in the photos are identified using reliable local sources as intelligence processing facilities. This determination adds operational value to the buildings. Another level of investigation might conclude the buildings housing the processing facilities belong to a neutral country involved in the conflict. The buildings are not targeted but maintain their operational value.

The engagement process provides an avenue to add value to potential targets. The following paragraphs describe the components of the engagement process. Appendix C contains descriptions, in terms of resources, and the UML activity diagrams.

(1) Detect. "Detection involves collecting, correlating, and assessing information from all sources; from observers on scene, to highly sensitive real-time intelligence data, to information archived in special intelligence databases." (TCS CONOPS, 15) The detection cycle is a balance between decision-maker requirements and available sensor resources. The process relies on the decision-maker's ability to keep abreast of the operational situation and make priorities known to others involved in the detection cycle. Its associated activities provide a means for decision makers to state detection requirements and make detection resources available. These activities begin with decision makers setting their detection priorities. Targets are detected by various sensor sources, and the data is correlated and fused. Cueing priorities are reevaluated and disseminated. The activities are complete when decision makers confirm targets and target information is shared with an added recommendation for mission tasking.

(2) Decide. The decision process is where "…all elements [of the engagement process] must work together to recommend the relative priority of the mission, the appropriate weapons systems option used to engage the target, what to target and how, and what coordination is needed to ensure adequate synchronization and deconfliction." (TCS CONOPS, 19) While the decide process follows the detection process in the logical engagement process, many activities conducted during this phase occur concurrently with the detection phase. Decision makers can prioritize targets and match desired mission effects with weapon types. They may also establish preplanned responses dictating which types of targets in particular areas will be engaged with which types of weapons. Conducting this type of planning concurrently affords decision makers the opportunity to move immediately to coordination and deconfliction, weaponeering, and mission tasking, as targets are detected.

(3) Engage. The engage component consists of two sub-processes: execution and planning for combat assessment. Execution is the fulfillment of the tasking developed in the Decide phase. Assessment planning ensures adequate sensor resources in advance of the engagement for battle damage assessment.

Execution of this process occurs in one of three ways, depending on the capabilities of the firing unit. These capabilities are the availability of sensor, decision-maker, and weapon resources. The three types of execution are decentralization, update mission, or new mission. Decentralized execution occurs when the firing unit has a sufficient amount of sensor, decision-maker, and weapon assets available, as in NSS/Single-Ship. This availability provides the firing unit with the responsibility to complete its own mission updates, target verification, coordination, synchronization, deconfliction, and execution (TCS CONOPS, 25). The update mission method of execution might occur when other decision-maker and sensor resources have completed the majority of mission planning. Updated mission information and targeting instructions are passed to the firing unit conducting the engagement, as in NSFS/Controlling Unit. In the another method of execution, the desired firing unit has insufficient resources to engage the target. Sensor and decision-maker resources generate a new engagement. By creating a new engagement, more resources are generated. Decentralization and update mission events lead to the execution and plan for assessment sub-processes, while the new mission event enters the detect-decide portion of the process at any point depending on the target information presented.

(4) Assess. Portions of the assessment process occur throughout the engagement. "All [the] assessments have one thing in common, they must determine from the information at hand whether there is enough to support a decision to engage or whether more information needs to be collected and evaluated." (TCS CONOPS, 27) The assessment process is the means used in determining if the engagement was successful, partially successful, or a failure. The value placed on the target by decision-maker resources in the assessment phase will determine to what degree the target reenters the engagement process. If the target is fully destroyed, it might be updated in the target database. A partially destroyed target might be updated and enter the engagement process again in the decide sub-process. A missed target might enter the process in the engage portion and be executed again immediately. The sub-processes and activities mirror those in the detect process.

## D. SUMMARY

The Business Process view has described the interactions between different resource types in the execution of the "engagement" process. Goals and problems associated with land attack have been introduced and explained. A resource structure was introduced organizing them into sensors, weapons, and decision makers. This chapter has depicted how these resources supply and control the process to achieve goals.

The "Call for Fire" was introduced as the key business event associated with land attack, leading to the engagement process. Decision points were used to determine how best to answer the "Call for Fire", with a Surface Strike mission or a Fire Support mission. Decision points were also used in determining which roles within the two missions would be applied in answering the “Call for Fire”. Baseline decision criteria and rule sets were established for each, thus creating a relationship between the business event and operating rules associated with each role.

A baseline business process view was introduced to show this relationship. The target resource was introduced as the value-added resource in the engagement process. The physical attributes of the entity remain the same; but the entity changes value, as decision-maker, sensor, and weapon resources are applied. Targets and decision-maker resources enter the engagement process. Sensor and weapon resources are supplied, as controlled by additional decision-maker resources, to achieve the land attack goals. Targets, in various states (destroyed, partially destroyed) serve as outputs to the engagement process.

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# V. BUSINESS BEHAVIOR VIEW

## A. INTRODUCTION

The "engagement" process and the "Call for Fire" have been introduced in the Business Process view. The Business Behavior View shows how the "engagement" process interacts with its resources, how it interacts with the "Call for Fire" event cycle, and how the elements of the "engagement" process interact as a system. The "engagement" process and "Call for Fire" event cycle create valid targets and successful engagements. The behaviors are described below.

- **Process-Resource Behavior**: Processes and resources interact as they progress through their sub-processes and activities. A process needs instances of control and supply resources to transform an input resource. Process-Resource Behavior captures this behavior with Assembly-Line modeling.
- **Process-Event Behavior**: Processes interact with business events. The business event triggers the beginning of a process or signifies its end. Process-Event behavior demonstrates how these interactions affect the outcome of the process, in terms of how the event cycle affects the release of resources.
- **System-Wide Behavior**: Processes and events form a system. Input is introduced to the system and through the interaction between the processes, resources, and events an output is generated that achieve the process goals. Systems analysis tools are used to demonstrate engagement system behavior.

## B. ERIKSSON-PENKER ASSEMBLY LINE MODELING

An assembly line diagram is a tool used by business process modelers to depict the interaction between the business process and packages of resources. The assembly line model is a useful method because it translates easily into information systems requirements. Requirements are generated from the references made to the resources as the process progresses. These references, when mapped to use cases (scenarios), provide software designers with a snapshot of system behavior. The packages of resources can be thought of as objects in an information system. "The references to the assembly line packages comprise information flow to and from the information system and show the interface between the business process and the information system." (Eriksson and Penker, 116)

The assembly line diagram consists of the business process diagram at the top of the model and the assembly lines of resources at the bottom. The assembly lines are represented as packages of objects. Two types of references exist. A reference is considered "read," or "write." The "read" reference is equivalent to a process acquiring an instance of a resource, while a "write" reference is equivalent to a process releasing an instance of a resource. Figure 4.1 depicts a generic assembly line model.

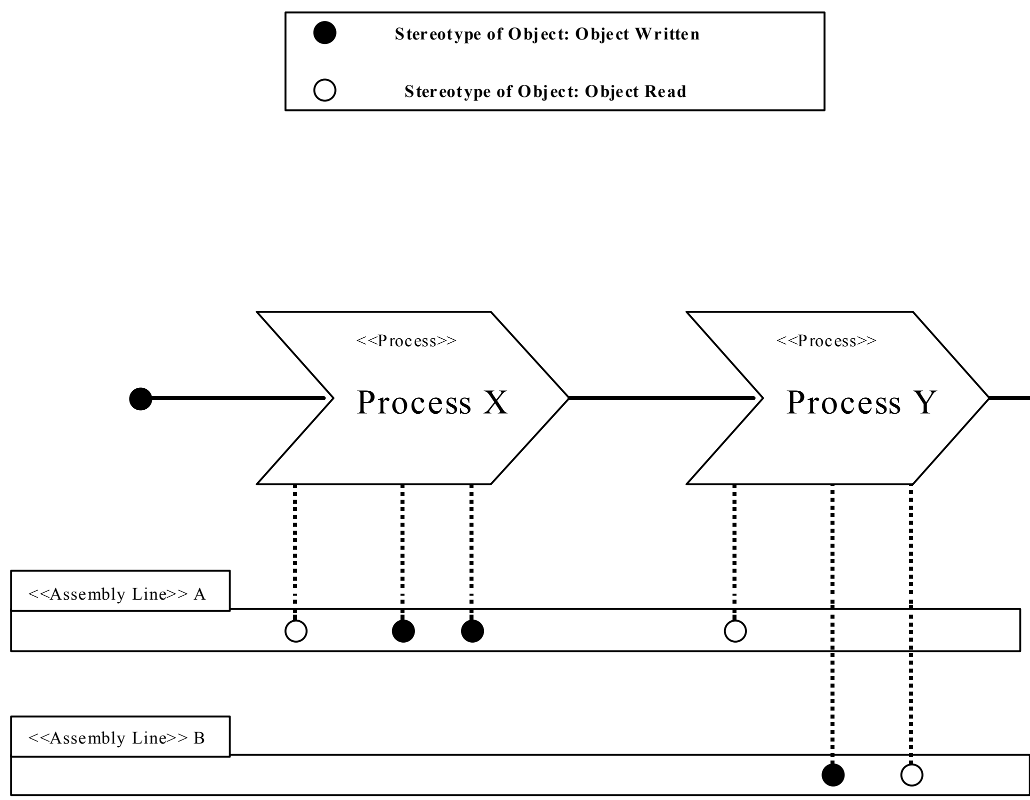


Figure (4-1) - Assembly Line Diagram (From Eriksson and Penker, 2000)

## B. LAND ATTACK BEHAVIORS

### 1. Process-Resource

Process-resource behavior, as demonstrated in the Assembly Line models, is shown in the interaction between associated sub-processes and activities and the available resources. It depicts how decision-maker resources, as control objects in the engagement process, use the network of decision-maker, weapon, and sensor resources to accomplish engagements. The descriptions of each process from the Business Process view have been used to determine the types of references made to the resource packages. The assembly line models and their associated reference packages are included in Appendix D.

#### *a. Network Behavior*

Decision makers conducting surface combatant land attack have access to a network of sensor, weapon, and decision-maker resources to conduct engagements. During the engagement process, the network is provided with instances of resources and responds to requests for instances of resources. It must reflect the additions, deletions, and modifications of resources as they are consumed.

Target information is retrieved and supplied to the network throughout the course of the engagement. Higher levels of providing rather than retrieving instances of resources characterize the detect, decide, and assess phases. Providing resource instances in these phases requires capacity and integrity. Instances of these processes provide target information and decision-making in terms of collection priorities, commander's intent, and imaged target data. The network receives the instances and catalogs them with respect to time and content. Retrieving resource instances in these phases require responsiveness. For example, an instance of the engagement process is initiated against a mobile surface-to-air missile battery. The battery poses an immediate threat to advancing friendly aircraft. An NSFS's "Call for Fire" initiates the engagement. Engage phase behavior is characterized by high amounts of both retrieving and providing actions. In the early phases of engagement execution, the network responds to high levels of instance retrieval. Decision makers and weapons need instances of target-information and sensors to conduct the engagement. As weapons are launched, the network is provided with instances of target and battle damage assessment information.

Networking resources mitigates environmental complexity. The network is stressed and strained as the engagement process unfolds. The need to update the commander's intent, access updated target information, and task sensors to collect target data stresses network resources. Factors, such as the number of engagements being conducted, the availability of resources, and the engagement's complexity affect how the engagement process executes. A single unit conducting a strike against a group of targets independently stresses available resources less than multiple units engaging targets in support of a maneuvering force of combined air and surface forces. Identifying the references to the resource network, at all points during the processes, identifies potential problem areas. This understanding leads to the design of a resource network and associated processes that decreases the effects of those stresses and strains.

### 2. Process-Event

The type of fires required is a key portion of the land attack engagement process. The engagement process and the business event cycle interact to produce the desired results. The interaction determines what type of supplying and controlling resources are available for consumption to achieve the engagement process goals.

The Surface Combatant Land Attack *CONOPS* lists three types of fires utilized by decision makers during land attack operations. They are:

- **Tactical Fires**: Fires characterized by short response times (a few minutes or less). Targets engaged with tactical fires are of an immediate threat to friendly forces. These fires are delivered in proximity to friendly forces and require detailed coordination and integration.
- **Operational Fires**: Fires characterized by relatively short response times (tens of minutes). Targets engaged with operational fires have a potential to threaten friendly forces. These fires are delivered at some distance from friendly forces.
- **Strategic Fires**: Fires characterized by long response times (hours) because the targets are fixed or are not in a position to immediately threaten friendly forces. These fires are delivered at a considerable distance from friendly forces.

Decision makers from all levels of the land attack organization control the release and consumption of resources. The "Call for Fire" business event cycle acts as an intermediary between the targets to be engaged and the resources available to complete the processes. The rule sets defined in the business event cycle release decision-maker resources in the land attack organization. Once released, the decision-maker resources control the consumption by releasing those additional resources necessary to conduct the mission dictated by the combat situation. The business rules defined in the event cycle provide a conduit through the various resources to achieve mission success.

Two examples illustrate these effects. Mortars and artillery engage an infantry company in the direction of their advance. The company commander initiates a "Call for Fire." The fire support coordination agency responds with naval gunfire. A surface combatant providing direct support to the infantry company engages the target with tactical fires. In a pre-emptive strike, decision makers on the Joint Targeting Control Board (JTCB) elect to engage fuel and ammunition dumps during the assault. Enemy POL (petroleum, oil, and lubricants) sites, 100 nautical miles from the advancing force, have been detected using remote sensing from Special Operations Forces. This mission requires a coordinated, dual-ship "engagement." The "Call for Fire" is answered with strategic fire, in a multi-ship surface strike mission.

Decision makers, as controlling objects in the business process, use the required response time and the proximity to friendly and neutral forces to determine which resources from the network are necessary to accomplish the engagement. In the case of a target in close proximity to friendly forces that poses an immediate threat, one set of resources from the network is required. A flatter decision-making hierarchy, with fewer constraints, is needed to ensure a speedy response. The ability to sense the environment quickly and accurately is necessary to avoid fratricide. Precision weapons with faster response times, such as Extended Range Guided Munitions (ERGM) rounds fired from naval guns rather than Tomahawk missiles, are required to eliminate the threat quickly. But, a stationary target, miles away from friendly and neutral forces engaged preemptively, requires a different set of responses. Coordination and deconfliction become more important than responsiveness in decision making for this instance. Sensors update imagery of the target and provide local deconfliction for the firing unit. Because desired mission effects outweigh response times, the type of weapon used is less constrained.

### 3. Systems-Wide

In the last chapter, the "engagement" process and the "Call for Fire" event cycle are described in a linear fashion. Unidentified entities were chosen for strategic, operational, and tactical value in the decide process. Sensor resources were consumed in the detect process to find them. As a result of a "Call for Fire", the engage process took the detected target and launched fires at the target. The outcome of the engagement was determined in the assess process.

"Systems thinking is a discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static 'snapshots'." (Senge, 68) Systems can be described in terms of reinforcing and balancing feedback loops and delays. Reinforcing feedback is an amplifying mechanism in a system spawning growth or decay. Balancing feedback serves as a mechanism to counteract the growth or decay and bring the system to a null state. Time affects how rapidly the reinforcing feedback grows and how fast the system balances. Analyzing the engagement process using these tools generates two conclusions. First, in complex system, there is a tendency to take premature action to correct perceived gaps. This tendency, when coupled with a shared pool of resources, has the potential to create a situation where, as more engagements enter the system, the shared pool of resources reaches a limit where quality is adversely affected.

The land attack system is comprised of an input and output system designed to take corrective action based upon actual conditions. The engagement process, as the corrective action in this system, acts upon targets using resources to achieve system goals. The engagement sub-system is comprised of the elements of the engagement process. The elements compete for network resources to accomplish missions. As corrective action continues to be induced, more targets (inputs) enter the engagement system. The decide and detect sub-processes consume network resources to generate planning and targeting to prepare for strikes. The engage and assess sub-processes consume network resources to execute and assess the strikes.

The engagement process shares a common resource pool. As more decisions to engage targets enter the system, more strain is placed on these resources. Both sub-processes of the engagement process are designed to create increasing value and consume the resources necessary. This causes the supply of resources to decrease. As available resources decrease, the tendency is for the demand for resources to increase to compensate. This creates further depletion of resources. The value generated in both sets of processes decrease.

## C. SUMMARY

This chapter is the final view of the *Business Architecture Model for Surface Combatant Network-Centric Land Attack Warfare*. Goals and problems, resource structures, and the processes associated with land attack warfare have been developed and explained. This last chapter analyzed business behavior on three levels: process-resource, process-event, and system-wide. Tools, such as assembly-line modeling and systems analysis, were used to describe this behavior.

Assembly-line modeling, chosen for its applicability to information systems, analyzed the business processes against resource packages. An assembly-line model for each land attack process was created using sensor, weapon, decision-maker, and target-information resources. References were categorized and described for each process. The analysis focused on how resources were consumed and developed patterns of network use during each phase of an engagement. Process-event behavior analysis yielded an understanding of the purpose of the business event cycle in releasing the proper amount and degree of resources for the engagement being conducted.

This analysis was sufficient to gain a linear understanding of the engagement process. High-level systems analysis was conducted to describe the interactions between the processes. Analysis concluded that in the land attack system an overall decrease in the quality of engagements, due to an exhaustion of shared resources, can be experienced because of high levels of premature corrective actions. This behavior is attributed to the nature of the reinforcing growth loops and the time delays inherent in their design.

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# VI. SUMMARY AND CONCLUSIONS

The *Business Architecture Model for Network-Centric Surface Combatant Land Attack Warfare* is a strategic planning tool for use in C4ISR-T system development. The foundation of the strategic planning process is that the business direction and requirements must drive the information systems direction and the computing architecture (Cassidy, xv). The land attack business direction and requirements have been presented using the Eriksson-Penker Business Extensions tool kit for the Unified Modeling Language (UML). The complexity of the land attack business direction and its requirements will lead to similarly complex information systems' direction. The land attack warfare processes, goals, and structures will mature as they progress to meet the operational requirements of 2015. This model must mature in concert to ensure adequate Land Attack C4ISR-T system support.

## A. SUMMARY OF THE LAND ATTACK BUSINESS VIEWS

The goal of creating this business architecture model was to gain an understanding of the land attack to develop supporting C4ISR-T systems. This Eriksson-Penker Business Extensions tool has depicted the land attack business using four views: the Business Vision, the Business Structure, the Business Process, and the Business Behavior.

The Business Vision view introduced the concept of a C4ISR-T system. These systems integrate sensors, weapons, and decision makers in an operating environment. The land-attack operating environment is complex in terms of potential geopolitical situations, physical operating environments and missions, and the realities of smaller crew sizes. The vision view outlined the goals of conducting land attack warfare and the problems associated with achieving them. Proposing changes to organization and doctrine have the potential to mitigate the effects of the environmental complexities. Organizing a force's sensors, weapons, and decision makers in a network and applying new organizational characteristics to land-attack command and control will aide in achieving a fully integrated land attack capability

The Business Structure and Process views depict how the business of land attack is conducted through resources, business processes, and events. The Business Structure view organized land attack resources for network use. Platforms conducting land attack provide their sensors, weapons, and decision-making resources to the network. This view depicted the structure of the land attack resources in three groups: the network resources, the information, and the organization. The Business Process view developed the land attack core processes and business event cycles. The Process view introduced the target resource as the value-added resource in the engagement process.

The Behavior View described the interaction between processes, events, and resources. Behavior is shown in terms of processes and resources, processes and events, and the behavior of the parts as a system. Processes and resources interact and load the network at various levels through the execution of the engagement process. Processes and events interact to release the proper types of supplying and controlling resources to execute the engagement process efficiently. As a system, the engagement process is described as a reinforcing growth structure that is balanced by input-output mechanisms. Both time delays and a common resource pool can place heavy strains on the resource pool that affects engagement quality.

## B. CONCLUSIONS

The business architecture model has described the business direction and requirements and proposed operating in a network-centric architecture with improved organizational structures to effectively deal with a complex environment. The future of land attack warfare involves overcoming complexities. These complexities exist in the mission, its processes and events, and in its intended operating architecture. Overcoming these complexities is a large hurdle for systems developers. The effects of this complexity may be mitigated by gaining a common understanding of the business architecture model through further analysis of its constituent parts.

Naval Surface Fire Support and Naval Surface Strike are complex by virtue of the missions they are designed to conduct. Land attack uses sea-based fires to engage targets deep in the enemies' territory. In a simple engagement, the projectile flies through the air at its intended target, time passes, and the projectile hits the target. In a more complex engagement, another projectile flies through the air at its intended target. The projectile's flight path passes through a portion of airspace shared with inbound assault aircraft, time passes, and the projectile hits the target. With an even more complex engagement, the next projectile flies through the shared airspace. As time passes, the intended target has moved and the projectile hits a column of advancing friendly infantry. Decision makers require information about the target, their weapons, and their surroundings. The amount of information and the time constraints and accuracy involved in processing it generate high levels of task complexity.

The engagement process and the "Call for Fire" event cycle introduce another aspect of complexity. As modeled here, the Process View decomposed the engagement process into four sub-processes. The four sub-processes contained anywhere from two to seven activities. The activities can be further and further decomposed. Each activity interacts with resources. Each has specific goals and requires input objects, supplying objects, and controlling objects to achieve them. The "Call for Fire" event cycle consists of three decision points and ten different sets of rules. Throughout the execution of the engagement process, resources interact with processes; and processes interact with the event cycle. The resource network is changed frequently as a result of this interaction. The Process and Behavior views, for simplicity, represented one target, one engagement, and one platform conducting it. The complexity only grows as more platforms contribute and interact with the resource network, as more targets are introduced, and more engagements are ordered.

The development standpoint highlights another aspect of complexity. The network-centric architecture is complex. It involves linking networks together to achieve a desired result. For example, an organization has offices in Utah and Maine. Each office has its own network to conduct separate tasks, but they require information and resource sharing between the two. They establish a connection via the Internet to conduct their business. The Internet is an example of a network-centric architecture. It is a network of networks designed to provide its users with information and services. The land attack example is similar. Each land attack platform has a network of sensors, weapons, and decision makers. These platforms provide resources from their network to a common network to complete tasks. These platforms use the common network to communicate with each other, but use other outside networks to access additional services. The number of networks in the land attack environment can add up quickly. While this architecture reduces environmental complexity by increasing the opportunity for collaboration and interaction, it achieves the result by creating a complex web of interactions. The web of interactions requires a high level interoperability and security and a set of processes to ensure that it is operating in an efficient manner.

Land Attack is a complex mission with complex processes. A Network-Centric view of C4ISR-T systems is a complex solution to the problem. The Land Attack CONOPS covered capabilities and systems development in the 2005-2015 timeframe. Various land attack programs are being developed to bring an incremental land attack capability to the fleet. The business architecture model presented here is a contribution to the dialogue on the future of land attack warfare and its C4ISR-T system development.

Modeling and simulation is a method for systems designers to build prototypes. The prototypes are used to run simulations using test parameters and conditions and test hypotheses. After the simulation is complete, designers collect data, conduct analysis, and report on their findings. Models can be changed and new simulations run to test new hypotheses. Adverse effects can be observed and analyzed, new information gathered from the data, and designers can thus learn more about what they are modeling. This process, when applied to the land attack business architecture model, provides an opportunity to achieve common ground on the direction of land attack warfare and its associated C4ISR-T systems. The modeling and simulations process, combined with the object-oriented nature of this business modeling tool, allow systems designers to conduct all levels of analysis on any part of the business model.

Land Attack Warfare is a new concept, but its elements are not. It comprises traditional surface warfare missions: strike warfare and naval gunfire support. It has borrowed chains of command and techniques and procedures from past and current operations. It has improved upon existing technology to create new weapons systems and capabilities. Smaller, lighter, and faster defense capabilities have played a major role in its development. The possibilities of crew size reductions have major ramifications on the task complexity and decision-making abilities. Surface combatant land attack warfare will be conducted in the midst of complexity, in its environment, its organizations, its missions, its doctrine, its processes, and its architecture. Robust and interoperable C4ISR-T systems that serve the decision makers as they operate in these increasingly complex environments must be developed with these considerations in mind.

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# APPENDIX A - BUSINESS VISION VIEW

Appendix A includes UML diagrams and descriptions of the goal/problem model associated with Surface Combatant Land Attack (LA) in a Network Centric Environment. This appendix contains two sections. The goal section includes a UML class/object diagram and an explanation of the goals associated with land attack. Each goal is described in terms of its type, description, and dependence. A brief narrative explanation and diagrams of the goal follows. The problem section explains each problem associated with conducting surface combatant land attack in terms of its associated goal, a description of the problem, its causes, actions to remedy the problem, and prerequisites for the remedial actions.

The goal/problem model depicts a specific goal as an object of the goal class. Super-goals may be completely or partially broken down into sub-goals and the constraint {complete} or {incomplete} describes this characteristic. A goal is constrained as {complete} when the goal has been completely broken down into subordinate goals. When all subordinate goals have been completed, the super-goal is achieved. A goal is constrained as {incomplete} when the goal has not been completely broken down into sub-goals. This may indicate that other events might be necessary to fulfill the goal even if all sub-goals are achieved.

The goal/problem model also describes the obstacles to achieving the business goal in the form of problems. Problems may be temporary, in that they might be solved once and for all, or they may be permanent problems, which may only be mitigated. Action plans may be developed for problems in the form of causes, actions to solve, prerequisites for those actions, and processes required solving them.

## A. GOAL DESCRIPTION

### 1. Land Attack Capability (G1)

| | |
|---|---|
| G1: | Land Attack Capability |
| Goal Type: | Qualitative |
| Description: | Integrate employment of LA process |

Project Combat power

Protect national interests

Achieve national and military objectives

Dependence: Yes

Complete/Incomplete: Incomplete

Narrative: The land attack capability has been defined in the Land Attack CONOPS as the integrated employment of available sensors, weapons, and forces (joint or coalition). The employment of these resources is used to project combat power into the ground portion of the battle space. The use of combat power must be in support of the national interest and of sufficient strength to achieve national and military objectives

**2. Integrative Land Attack Capability (G1.1) (Figure A-1)**

G1.1 : Integrated Land Attack Capability

Goal Type: Qualitative

Description: Level of conflict: Strategic, Operational, Tactical

Type of resource: Sensor, weapon, decision maker

Dependence: G1.1.1 Dynamic Battle Management

G1.1.2 Firepower

G1.1.3 Forces

G1.1.4 Execution

Complete/Incomplete: Incomplete

Narrative: Land attack is conducted at all levels of conflict. Resources in the form of sensors, weapons, and decision makers exist at all levels of conflict. An integrated land attack capability removes the coupling between the decision-maker, sensor, and weapon. Removing the coupling and making sensing (sensor), deciding (decision-making), and acting (weapons) a function of the network of resources available for use in a conflict adds value to the process. Integrating the land attack capability involves battle management, firepower, forces, and execution.

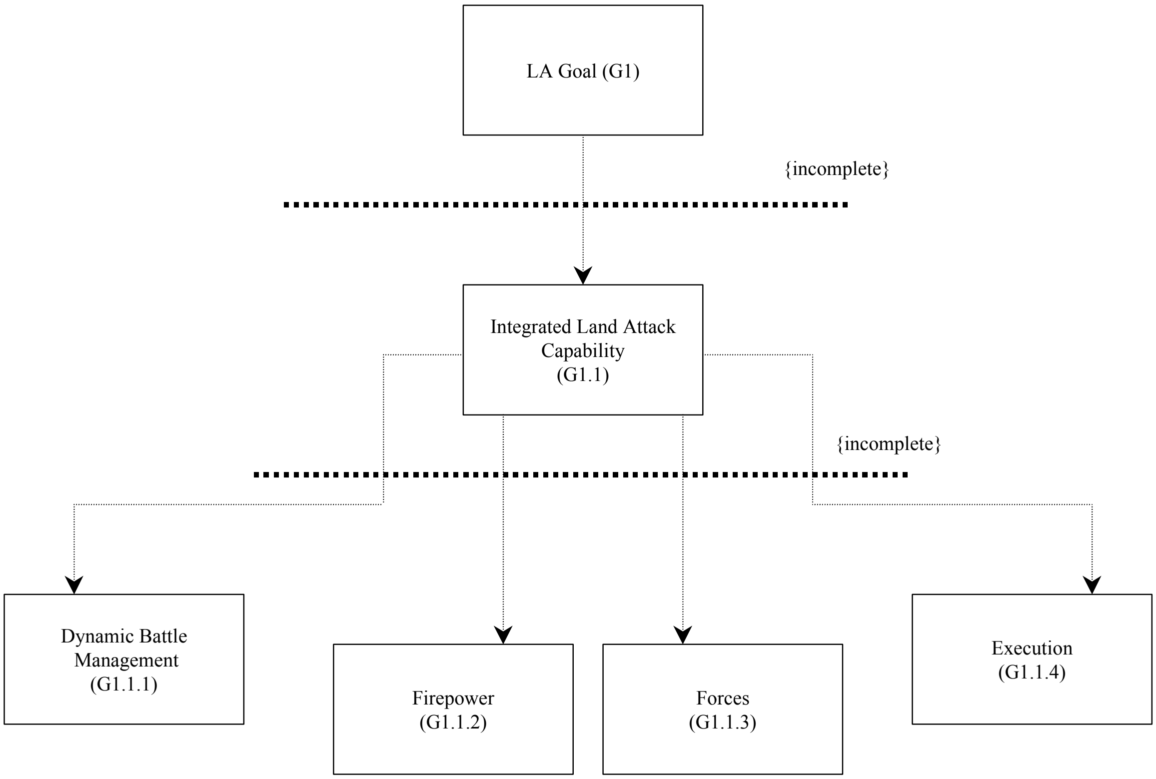


Figure (A-1) - Integrated Land Attack Capability

### 3. Dynamic Battle Management (G1.1.1) (Figure A-2)

G1.1.1: Dynamic Battle Management

Goal Type: Qualitative

Description: Support precise and scalable massed fires

Dependence: G1.1.1.1 Near Real Time Battlespace Deconfliction

G1.1.1.2 Simultaneous Fire and Maneuver

G1.1.1.3 Situational Awareness of multi-warfare tactical picture

G1.1.1.4 Control of resources in the battlespace

Complete/Incomplete: Incomplete

Narrative: Dynamic battle management must support precise and scalable massed fires. Land attack is conducted in conjunction with maneuvering forces. This requires situational awareness of the multi-warfare tactical picture that allows the commander to control resources in support of the mission objectives. Precision and scalability of fires is achieved by deconflicting the battlespace in near-real time.

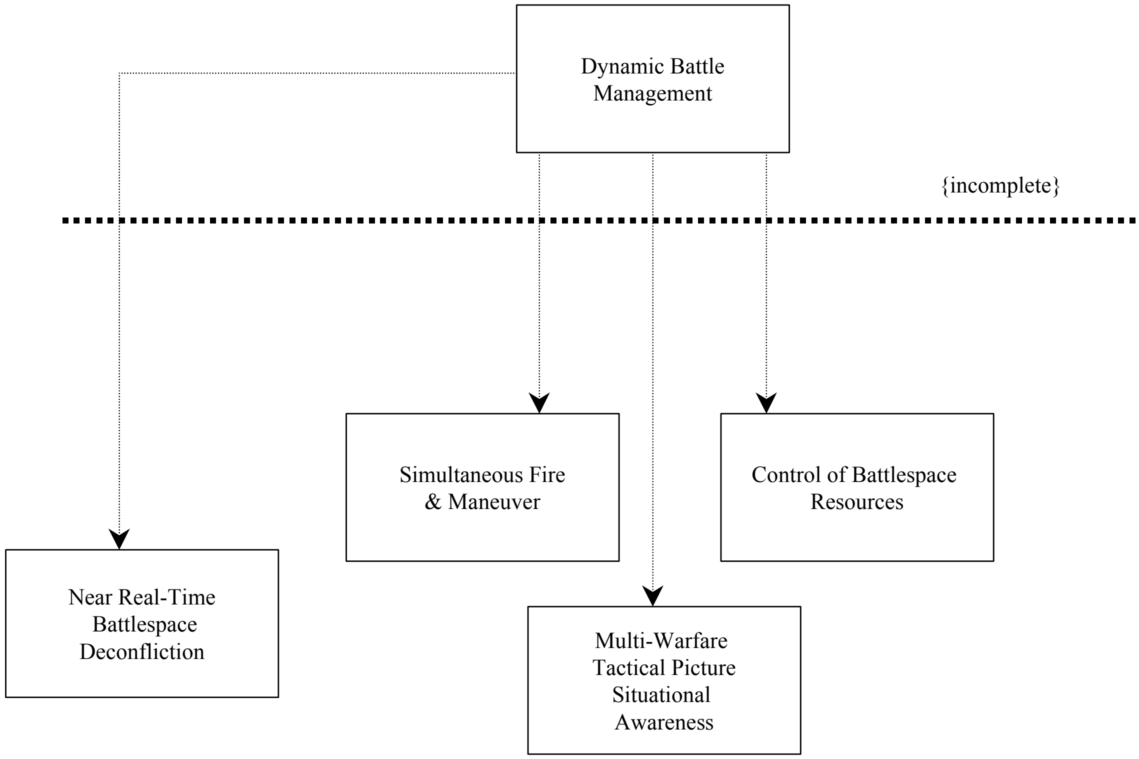


Figure (A-2) - Dynamic Battle Management

**4. Fire Power (G1.1.2) (Figure A-3)**

G1.1.2: Fire-Power

Goal Type: Qualitative/Quantitative

Description: Allocated dynamically from a network-based architecture

Dependence: G1.1.2.1 Dynamically allocated

G1.1.2.2 Precision Fires

G1.1.2.3 Scalable Fires

Complete/Incomplete: Incomplete

Narrative: Fires are logically removed from platforms and are consumed as a network resource. Networking available fires allows them to be dynamically allocated to achieve synchronization between firing units. Dynamic allocation provides precision engagement with properly scaled fires to achieve mission objectives. Dynamic allocation, precision, and scalability of fires have quantitative values associated with them. System response-time required by the maneuver commander is two and a half minutes from target detection to weapons away. Precision goals are between 750 and 1000 m CEP (Circular Error Probability) to friendly forces and 20-50 m CEP to targets. Scalability goals are reflected in required volume fires and explosive weight.

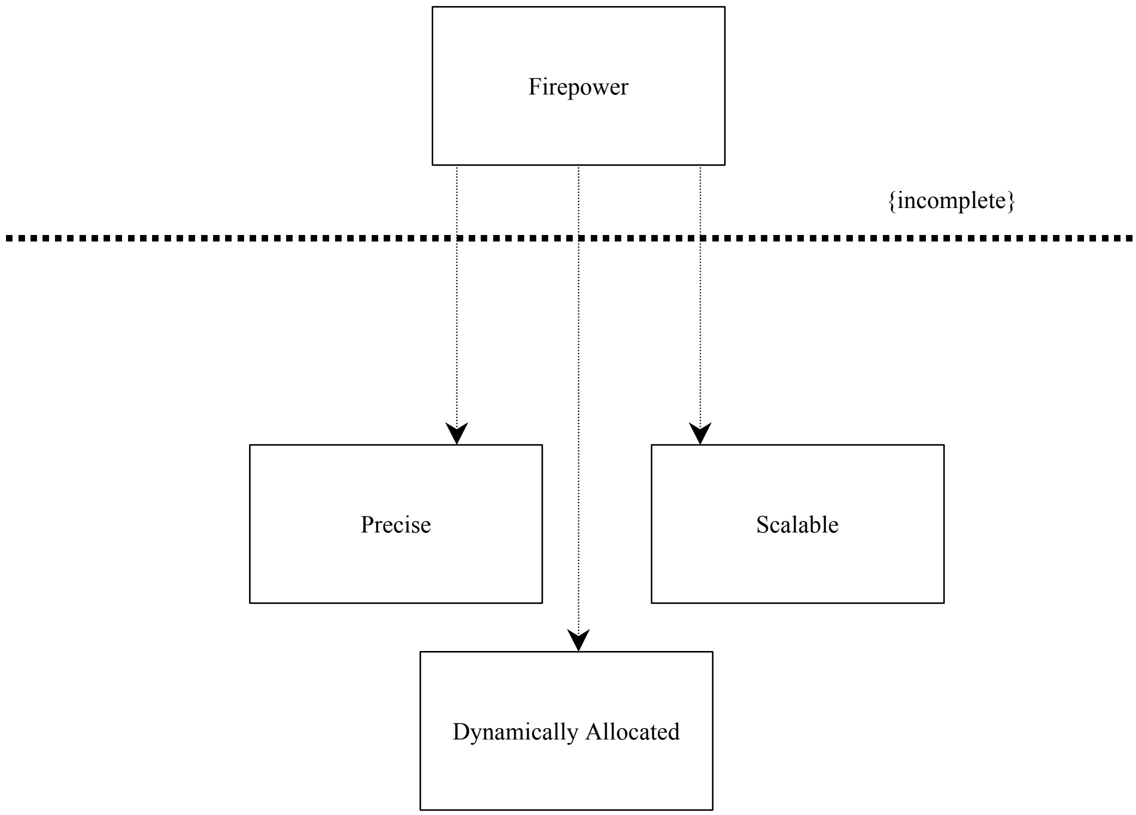


Figure (A-3) - Firepower

**5. Forces (G1.1.3) (Figure A-4)**

G1.1.3: Forces

Goal Type: Qualitative

Description: Allocated dynamically from a network-based architecture

Dependence: G1.1.3.1 Offensive

G1.1.3.2 Integrated

G1.1.3.3 Sea-Based

G1.1.4.4 Primary means of engagement

Complete/Incomplete: Incomplete

Narrative: Land attack forces must be able to conduct prompt, sustained, and synchronized operations. These operations will be conducted with combinations of tailored forces to specific roles and missions. The forces must have assured access and freedom to operate in any and all domains: air, land, sea, space, and information.

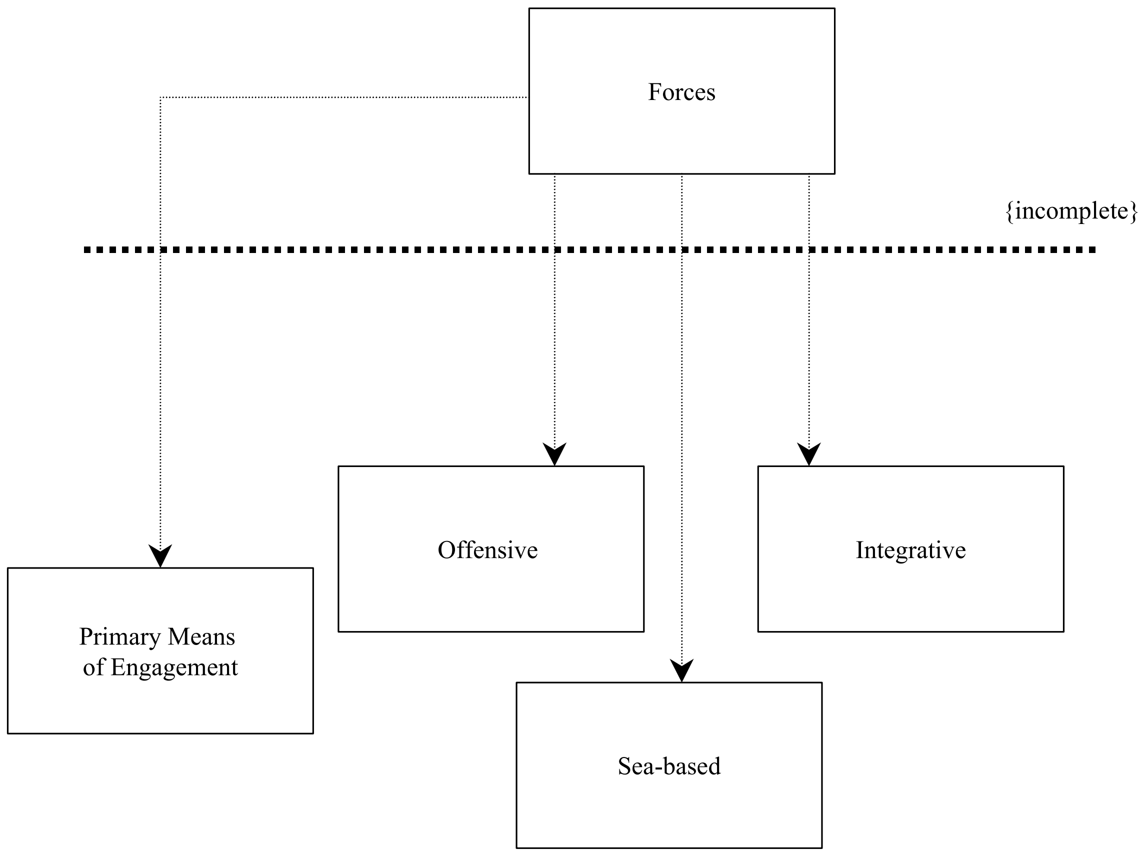


Figure (A-4) - Forces

**6. Execution (G1.1.4) (Figure A-5)**

G1.1.4: Execution

Goal Type: Qualitative

Description: Executed at the lowest possible echelon

Dependence: G1.1.4.1 Strategic level

G1.1.4.2 Operational level

G1.1.4.3 Tactical level

G1.1.4.4 "Sensor to weapons on target" timeline

Complete/Incomplete: Incomplete

Narrative: Land attack must be executed at the lowest echelons of command. Increases in the speed of command gained through a network-centric architecture are used to capture the element of speed and surprise. A "sensor to weapons on target" timeline respects the nature of the mission and its place in the hierarchy of operations. "Time-critical targets have importance from a tactical, operational, or strategic perspective and can be found throughout the battlespace." (Network Centric Operations-Time Critical Strike CONOPS, 2-3) Executing time critical strikes requires coordination and synchronization between independent, joint, and combined forces. Execution then requires the capability to share resources across echelons of command to ensure timely and effective responses.

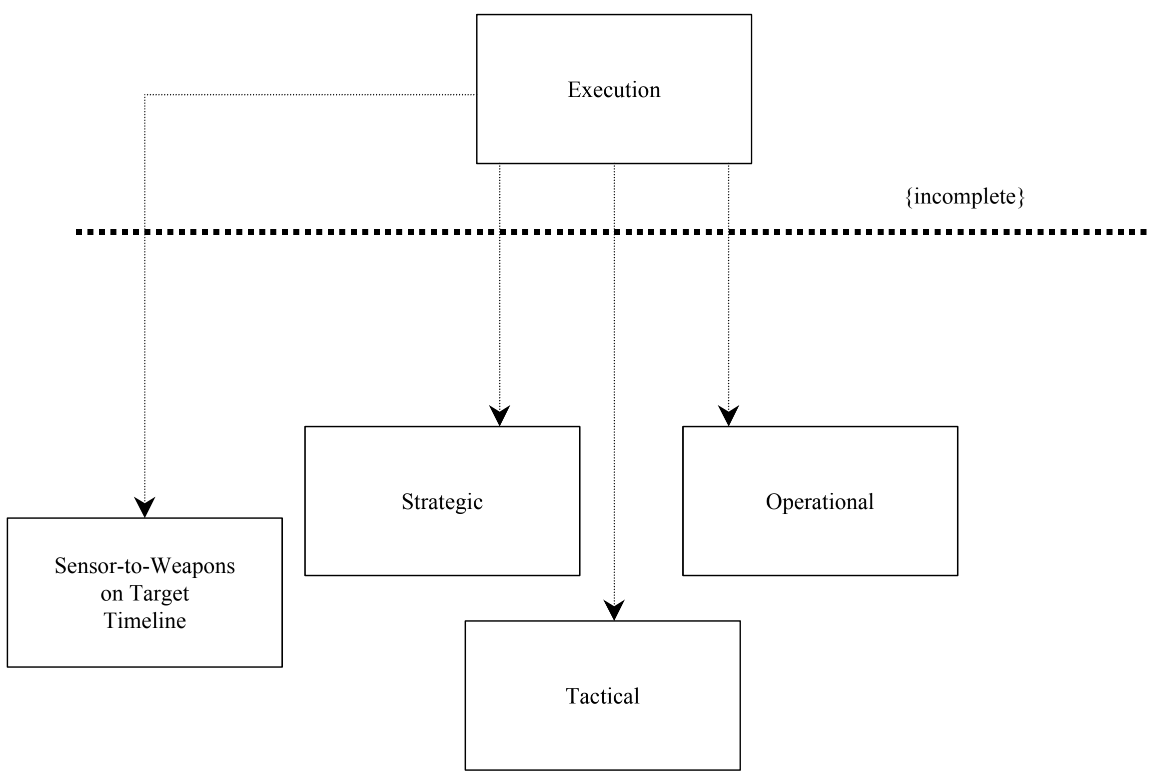


Figure (A-5) - Execution

## B. PROBLEM IDENTIFICATION

### 1. Environmental Dynamics

Problem: Environmental Dynamics (**Figure A-6**)

Associated Goal: LA Goal (G1)

Description: A hypothetical closing of the Straits of Hormuz provides a context in which to observe environmental complexity in various forms. The closing creates a geopolitical situation that is unacceptable to the United States. The Straits of Hormuz is a vital world-shipping lane. The ability for merchant vessels to pass through unimpeded is of a major concern to the global economy. The United States and its allies respond to the situation with a mission to reclaim the Straits. A MEF size assault is planned to free the Straits. The battle space is characterized by its proximity to land, volume of friendly troop movements, coordination and deconfliction of friendly fires supporting the movement ashore, and unit self-defenses and the protection of high-value units.

Causes: Global economic and social interdependency has made the free flow of commerce over the world's oceans a top priority. The US presence in the littorals aids in keeping these waterways open to global shipping traffic. The development of doctrines such as *Operational Maneuver from the Sea* (OMFTS) and *Ship-to-Objective Maneuver* (STOM) capitalize on speed, volume, and the element of surprise to achieve overwhelming force in the face of adversaries. This capability requires that supporting units, with increasingly smaller crew sizes, have the tools necessary to operate in this complex environment.

Actions: Organizational Change.

Doctrinal Change

Prerequisites: Understanding of the effects of environmental complexity

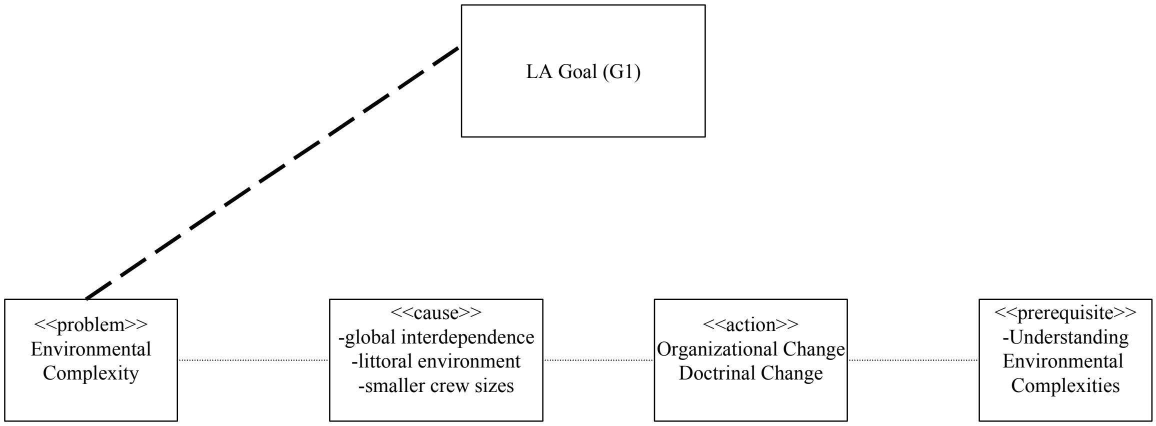


Figure (A-6) - Environmental Complexity

### 2. Organizational Change

Problem: Organizational Change (**Figure A-7**)

Associated Goal: Forces (G1.1.3)

Description: A fully integrated land attack capability in a network-centric environment increases the speed of command. Speed of command flattens command hierarchies and places decision makers in parallel with weapons and sensors (CONOPS, 2-1). Targets engaged with fires may be in support of maneuvering or independent of them. The command structure placed on weapons, sensors, and decision makers affects how these operations are conducted.

Causes: Command structures are in place to control the outcome of events in battle. Command and control comprises authority, responsibility, and intent. Authority, responsibility, and intent bound the mission and its objectives. Land attack is conducted at all three levels of conflict: strategic, operational, and tactical.

Actions: Current organizational structures and rules, with regard to fires in both the surface strike and surface fire support roles, should be reviewed and aligned with the goals of a network-centric architecture.

Prerequisites: Generate characteristics of information-age organizations and apply to command and control and organizational structure in land attack scenarios.

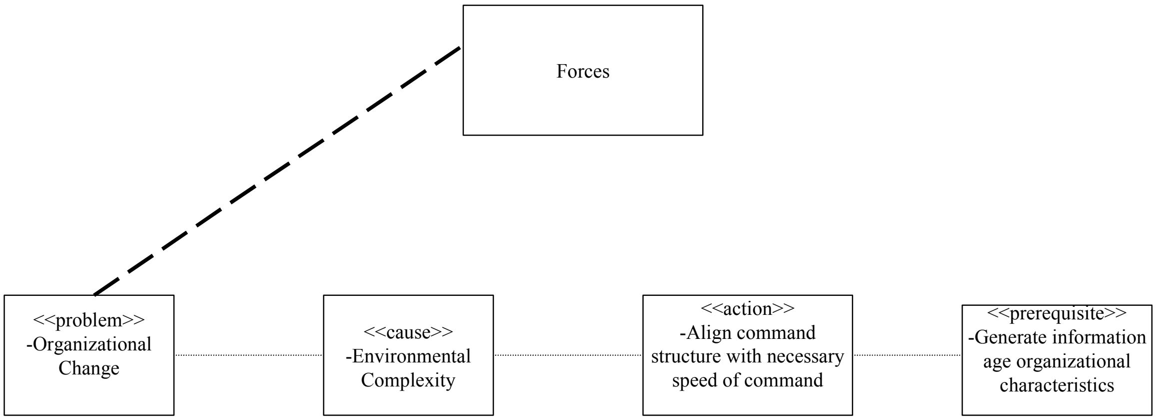


Figure (A-7) - Organizational Change

### 3. Doctrinal Change

Problem: Fundamental Doctrinal Change (**Figure A-8**)

Associated Goals: Execution (G1.1.4) and Dynamic Battle Management (G1.1.1)

Description: A fully integrated land attack capability in a network-centric architecture requires a dynamic battle management capability that provides commanders with full visibility of force weapons, sensors, and decision-making. The degree of environmental complexity present in land attack scenarios requires commanders to be proactive in their decision-making processes. Maintaining situational awareness in these highly complex scenarios is challenging.

Causes: The land attack mission definitions have increased the degree of complexity in the commander's environment. At-sea commanders in the naval surface strike roles are responsible for the planning, controlling, coordinating, execution, and assessment of surface-strike munitions both for their own units as well as those assigned in support. Units must be able to conduct surveillance and reconnaissance for the force with unmanned aerial vehicles (UAVs) and process, display, and disseminate that information to other forces in the operating areas. At-sea commanders conducting naval surface fires support missions have the use of long-range, deep penetration, guided munitions for use in support of maneuvering forces ashore. The speed and mass of the maneuvering force as it proceeds ashore, the mass of fires required in support of the maneuver, and the command and control relationships between a firing unit and a supported unit increase the need for rapid and dynamic command and control.

Actions: Precision and scalability in fires and forces requires units to operate in a networked fashion. Network-centric warfare is expected to provide more than a rapid and dynamic picture of the battle space. Placing decision makers, sensors, and weapons in parallel adds value to battle management by distributing the decision-making ability, weapons pairings, and forces across a wider area.

Prerequisites: Network-centric warfare must be applied to the land attack mission area in order to explore the implications of conducting the attack with a networked force.

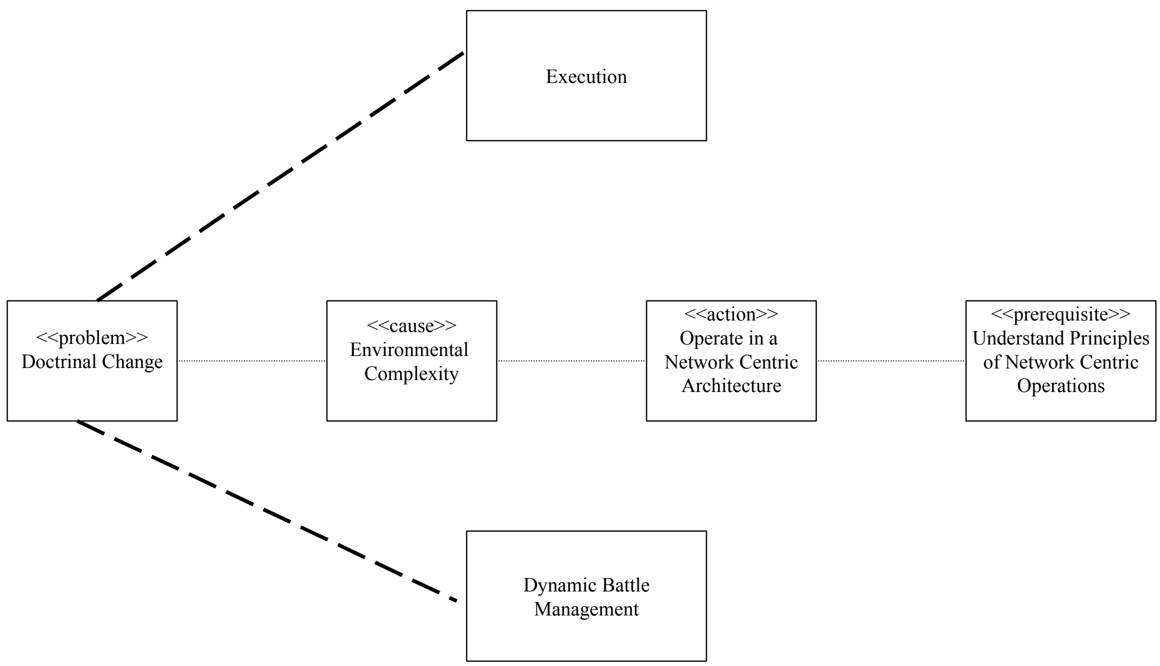


Figure (A-8) - Execution

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# APPENDIX B - BUSINESS STRUCTURE VIEW

The Business Structure View is comprised of three models: the resource model, the information model, and the organization model. UML class/object diagrams represent each of the land attack resource models. While they are represented in a physical hierarchy on the page, logically they are not hierarchic. The utility of the class/object diagrams is that the diagrams represent inheritance and specificity. For example, the Weapons Class resource has two objects associated with it: fires and electronic warfare. The fires and electronic warfare classes have specific instances that represent weapons and associated weapon systems. Associations are depicted between objects and instances by intervals listed on the connecting lines and by name. Each association is represented by a multiplicity, depicting the minimum number and maximum number of the relationship.

## A. RESOURCE MODEL

The resource model categorizes resources for use in network-centric land attack warfare. Descriptions of the resources are found in the Business Structure View. The models are presented in three sections: Decision makers, Sensors, and Weapons.

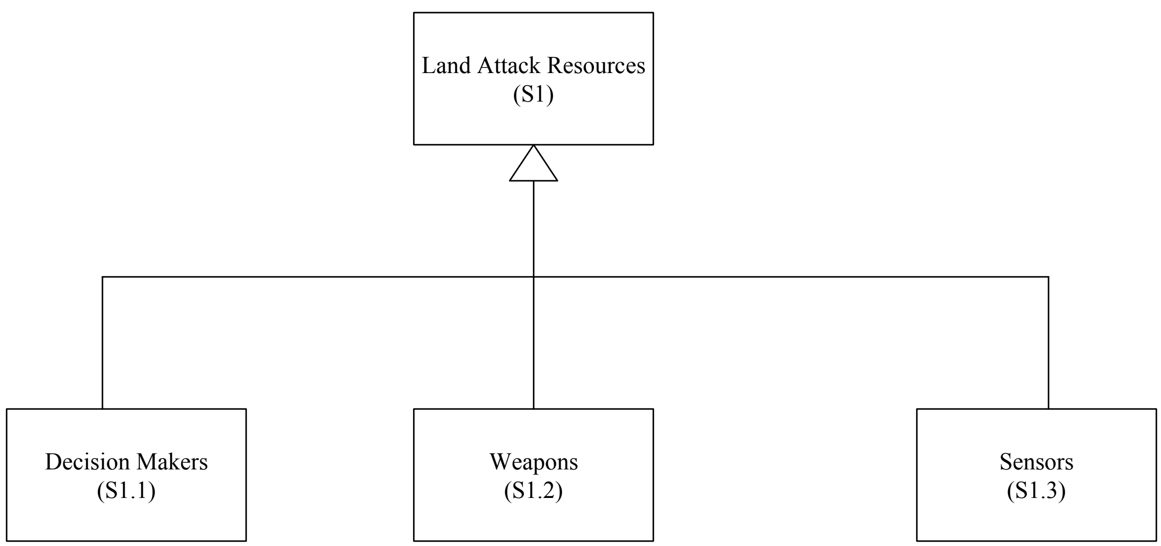



Figure (B-1) - Land Attack Resources

### 1. Decision-Maker Resources

Decision-maker resources exist at all three levels of conflict (Figure B-1). They are presented in this section in class-object diagrams depicting the types of decision-maker resources available at each level of conflict. They have been decomposed into strategic, operational, and tactical decision makers (Figures B-2 - B-6). The operational and tactical decision makers have been decomposed to reflect the specifics of the land attack warfare area.

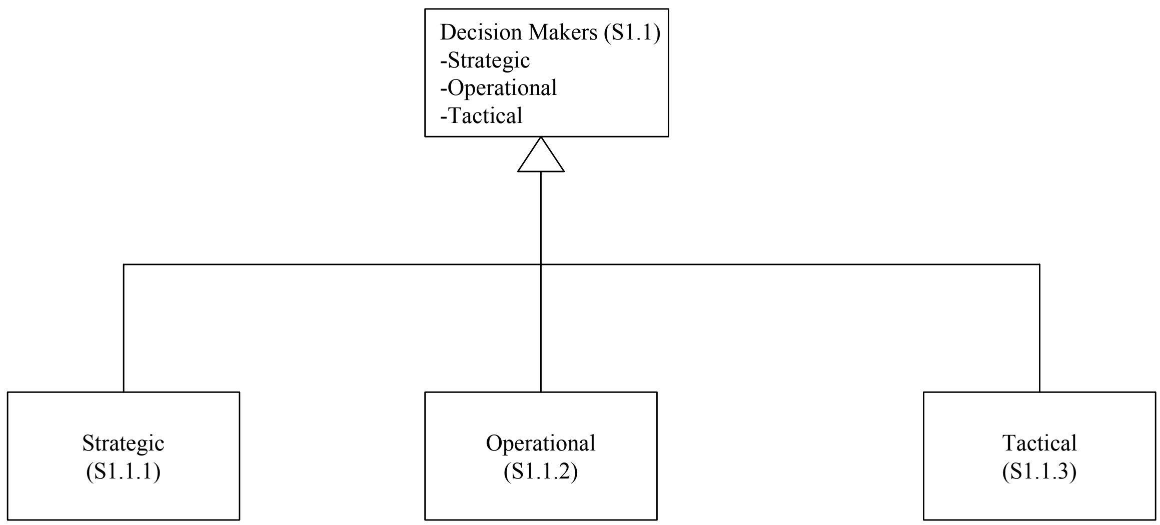



Figure (B-2)- Decision makers

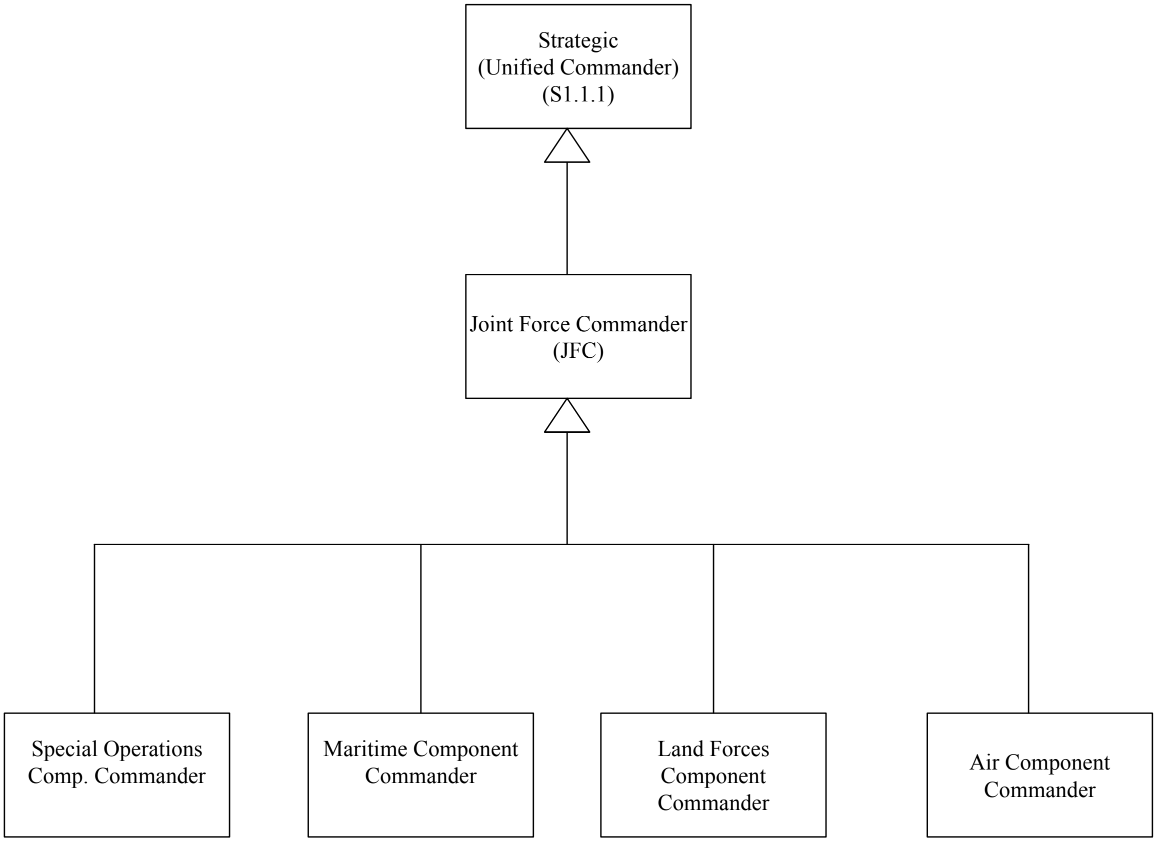
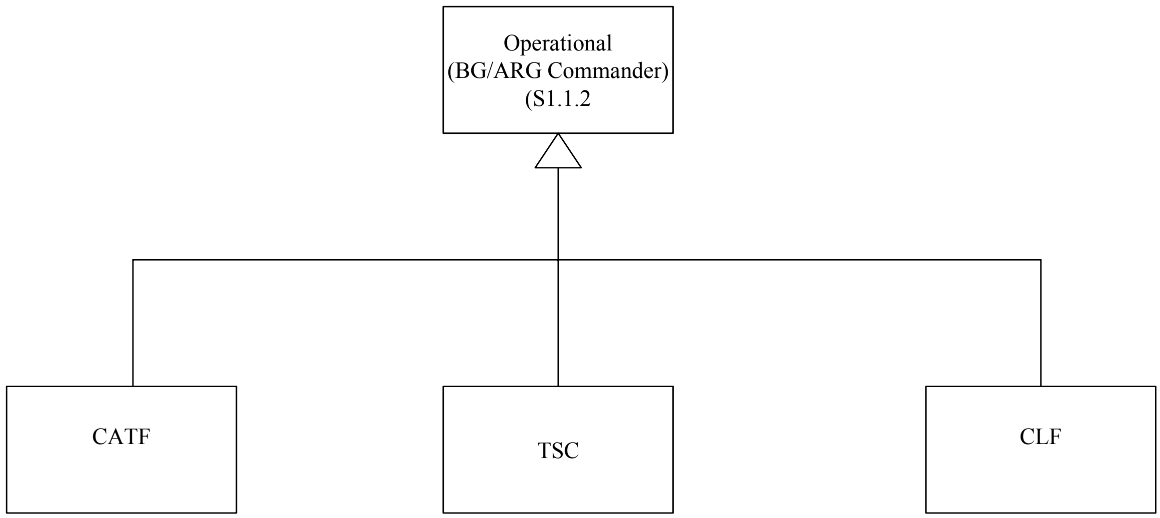
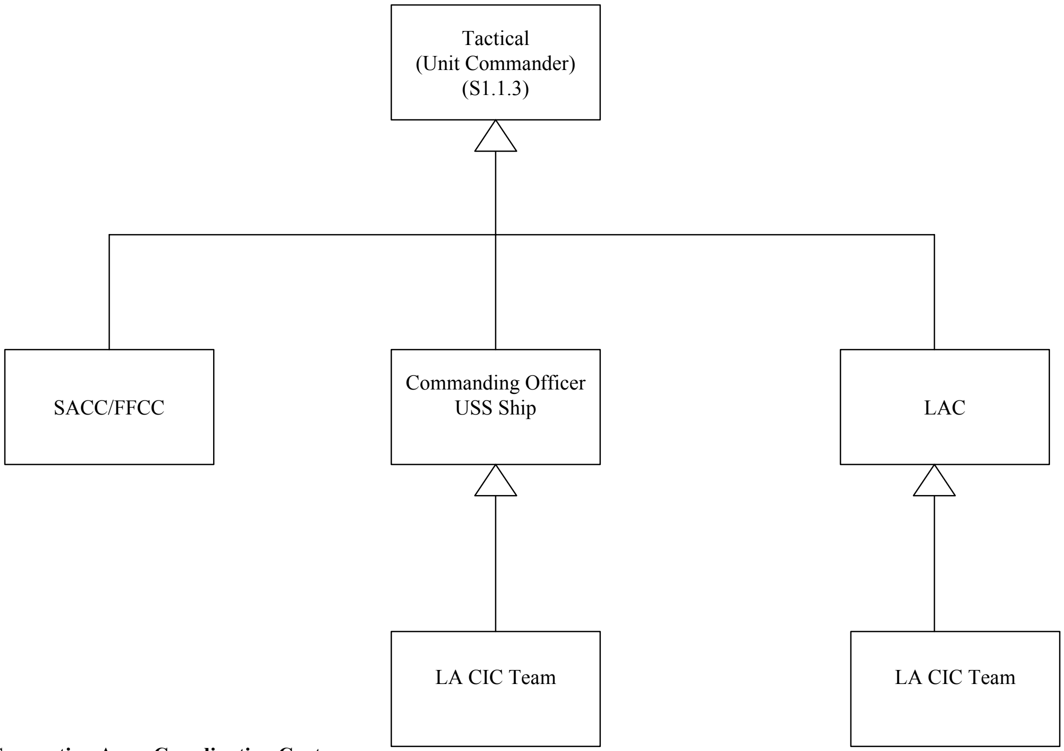



Figure (B-3) - Strategic Decision makers



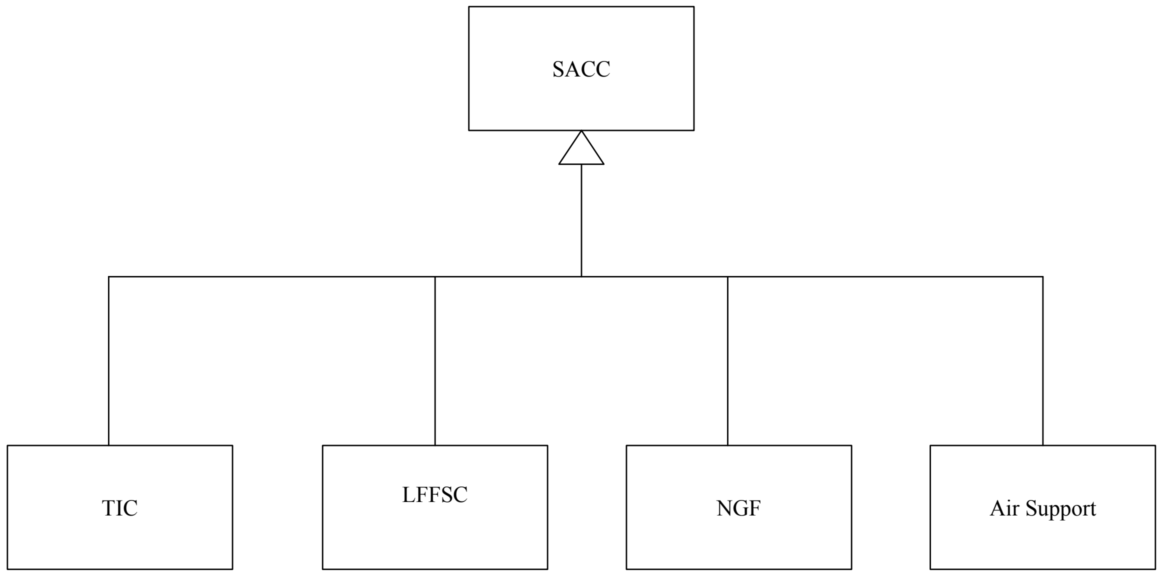

**BG- Battle Group**
**ARG- Amphibious Ready Group**
**CATF- Commander Amphibious Task Force**
**CLF- Commander Landing Force**
**TSC- Tomahawk Strike Coordinator**

Figure (B-4) - Operational Decision makers




**SACC- Supporting Arms Coordination Center**
**FFCC- Force Fires Coordination Center**
**LAC- Tomahawk Launch Area Coordinator**
**LA CIC Team- Land Attack Combat Information Center Team**

Figure (B-5) - Tactical Decision Makers




**TIC- Target Information Center**
**LFFSC- Landing Force Fire Suuport Coordination Center**
**NGF- Naval Gunfire Section**

Figure (B-6) - Supporting Arms Coordination Center

### 2. Sensors

Sensors provide target data for the engagement process. They have been categorized as surveillance, detection and tracking, and reconnaissance assets (Figures B-7 - B-10). Some sensors are organic to the land attack force, such as shipboard radar and unmanned aerial vehicles (UAVs). Sensor assets have been decomposed in the following diagrams.

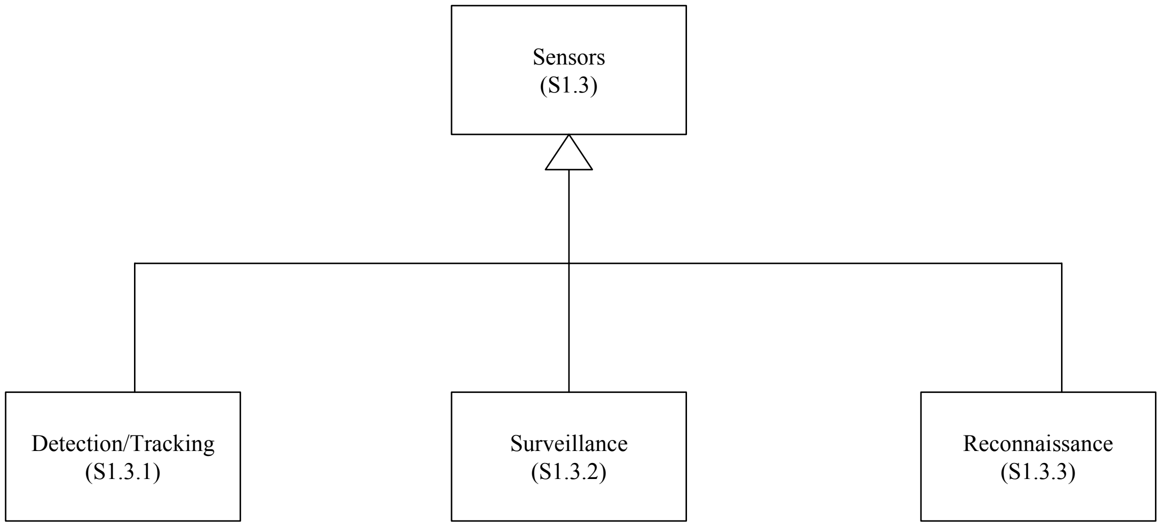
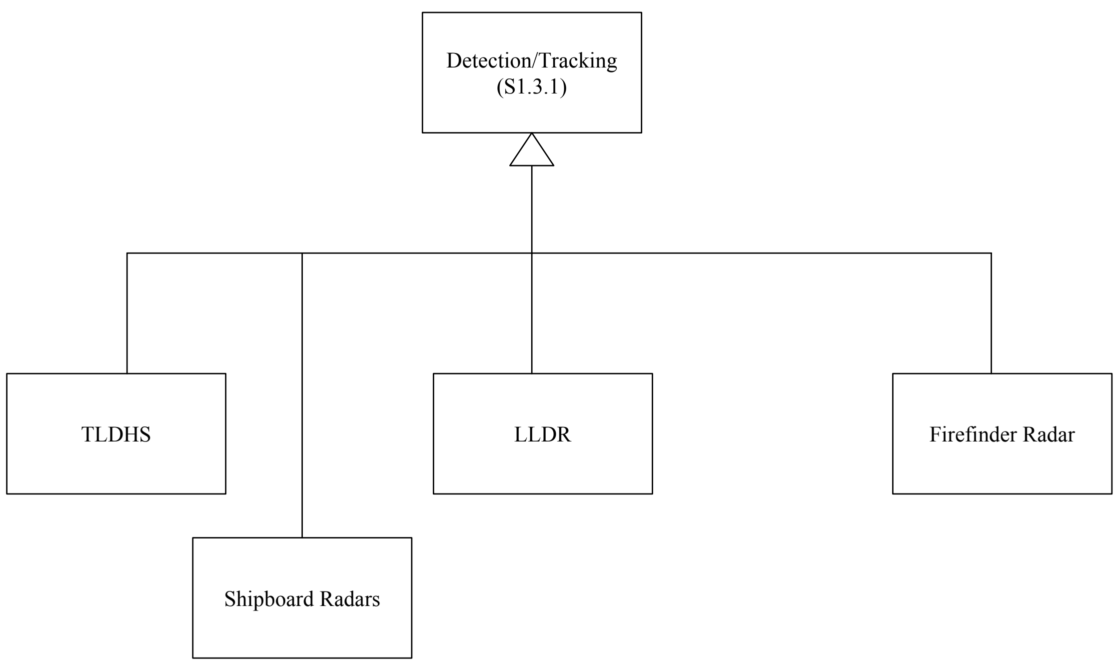
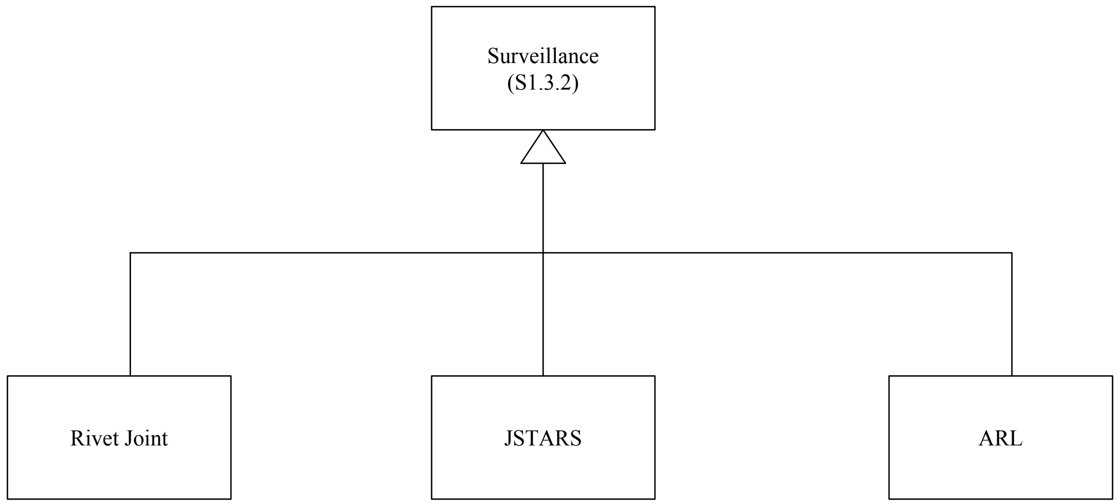



Figure (B-7) – Sensors



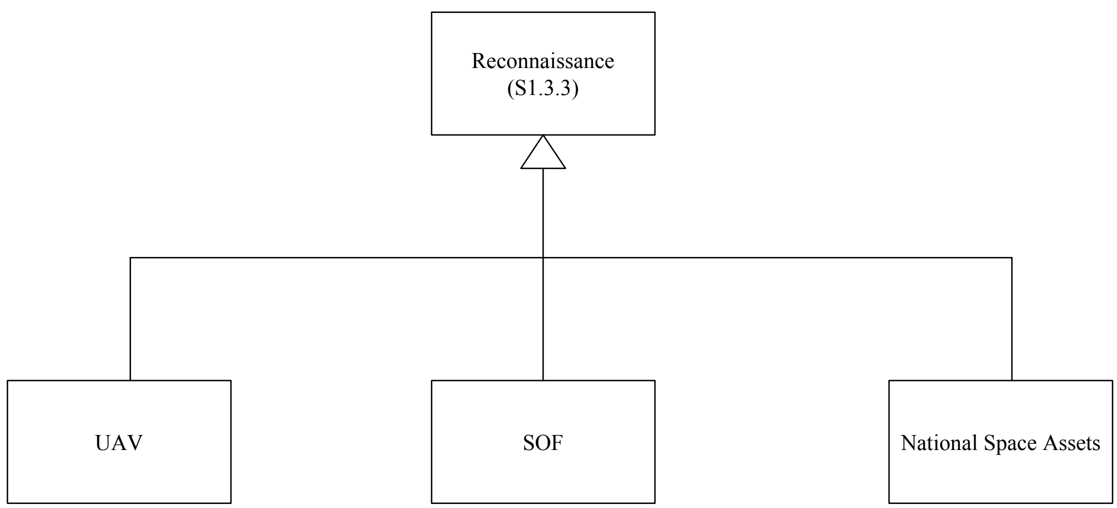

**TLDHS- Target Handling Designation Handoff System**
**LLDR- Lightweight Laser Designator Rangefinder**

Figure (B-8) - Detection and Tracking




**JSTARS- Joint Surveillance Target Attack Radar System**
**ARL- Airborne Reconnaissance, Low**
**Rivet Joint- Airborne COMINT/ELINT collector**

Figure (B-9) – Surveillance




**UAV-Unmanned Aerial Vehicles**
**SOF- Special Operations Forces**

Figure (B-10) - Reconnaissance

### 3. Weapons

Weapons are classified in three categories: Fires, Maneuver Forces, and Electronic Warfare (Figures B-11 - B-13). Fires and maneuver forces have been further decomposed in the following figures. The classification of this work precludes a discussion of electronic warfare.

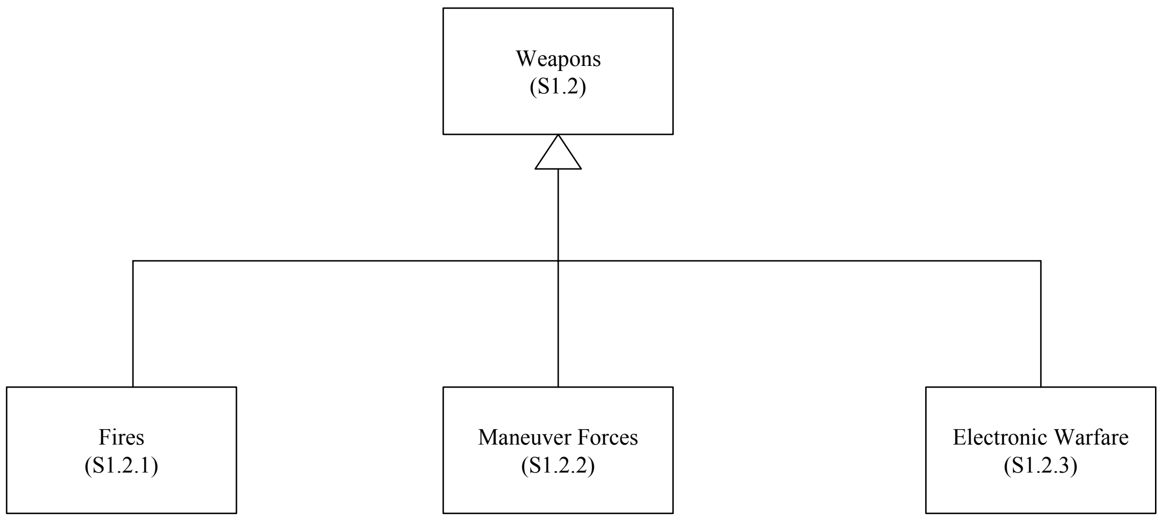
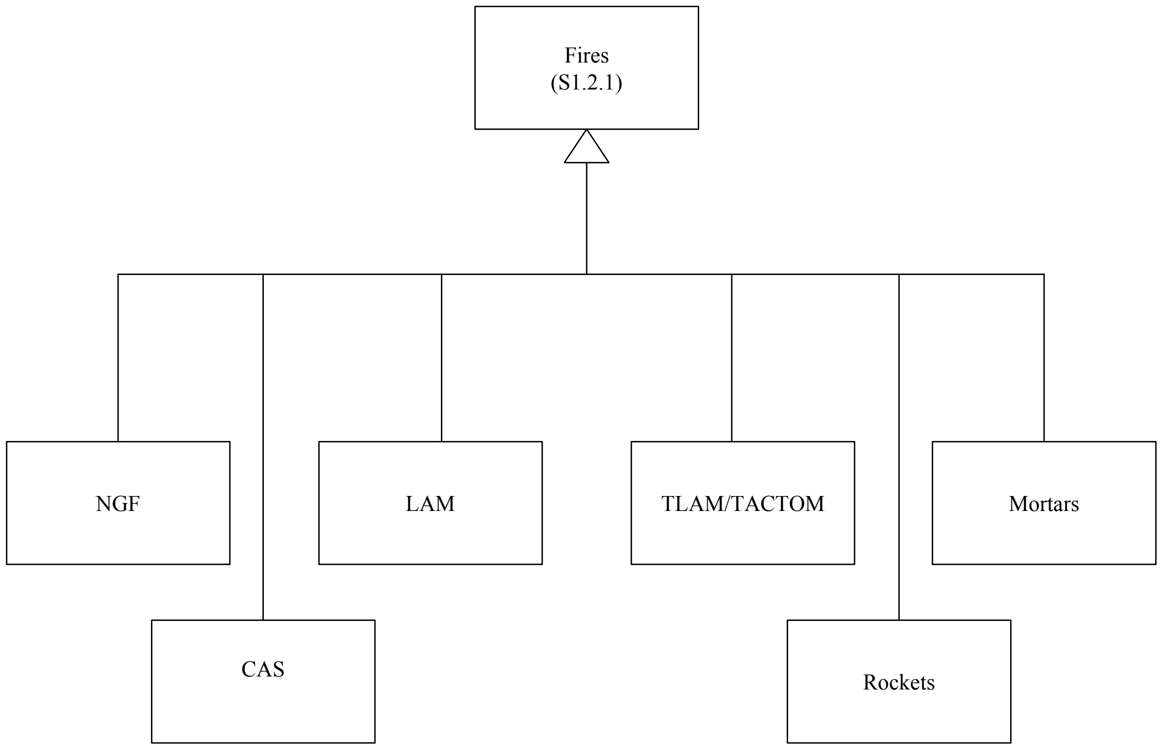



Figure (B-11) - Weapons




**NGF- Naval Gunfire**
**CAS- Close Air Support**
**LAM- Land Attack Missiles**
**TACTOM-Tactical Tomahawk**
**TLAM- Tomahawk Land Attack Missile**

Figure (B-12) - Fires

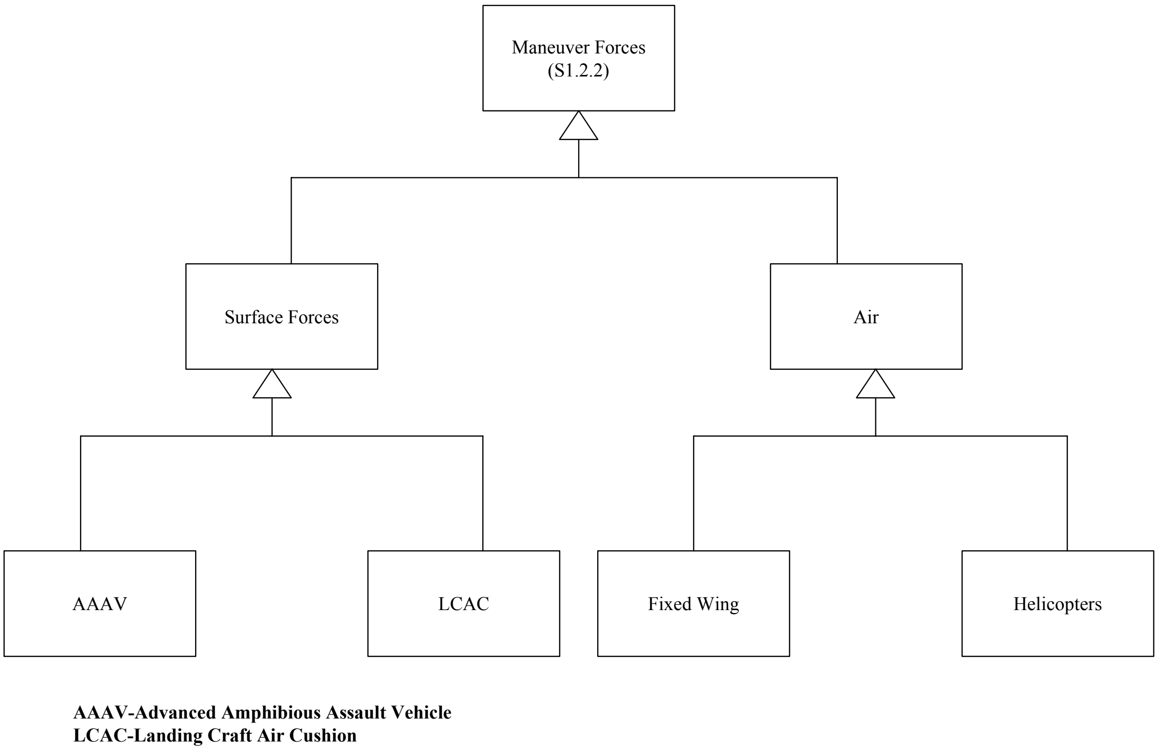



Figure (B-13) - Maneuver Forces

## B. INFORMATION MODEL

The information model consists of six classes (Figure B-14). They are defined as follows:

- **<u>Planning:</u>** Planning information is required in determining mission objectives and formulating commander's intent and rules of engagement. Planning information includes data about existing threats. It affects where firing units are placed and their ammunition load-outs. Planning information is affected by executed and assessed engagements.
- **<u>Targeting:</u>** Targeting information provides decision makers with the data required to target and plan firing missions. Targeting information includes what is to be targeted, whether it is detected, and what type of target it is. Targeting information also provides a priority for engagement based upon the target type.
- **<u>Coordination</u>**: Coordination information is used between firing units in coordinating existing plans. Coordination information includes spotter position, role of the firing unit, its condition, and its ability to carry out an assigned firing mission.
- **<u>Deconflcition</u>**: Deconfliction information is concerned primarily with an engagement. Deconfliction information provides a decision-maker with

the placement of friendly and neutral units as they relate to the engagement. Deconfliction information also aids decision makers in managing target lists by depicting the status of the target and the firing unit engaging it.

- **Execution**: Execution information depicts the specifics of the engagement. Fire mission information includes time, target number, location, description, and method of engagement. Execution information includes a firing report and the mission effects used in engaging the target.
- **Assessment**: Upon completion of an engagement, assessment information is generated. Assessment information includes battle damage assessment, re-attack plans, and the status of the re-attack. Assessment information is added to planning information in the form of updates.

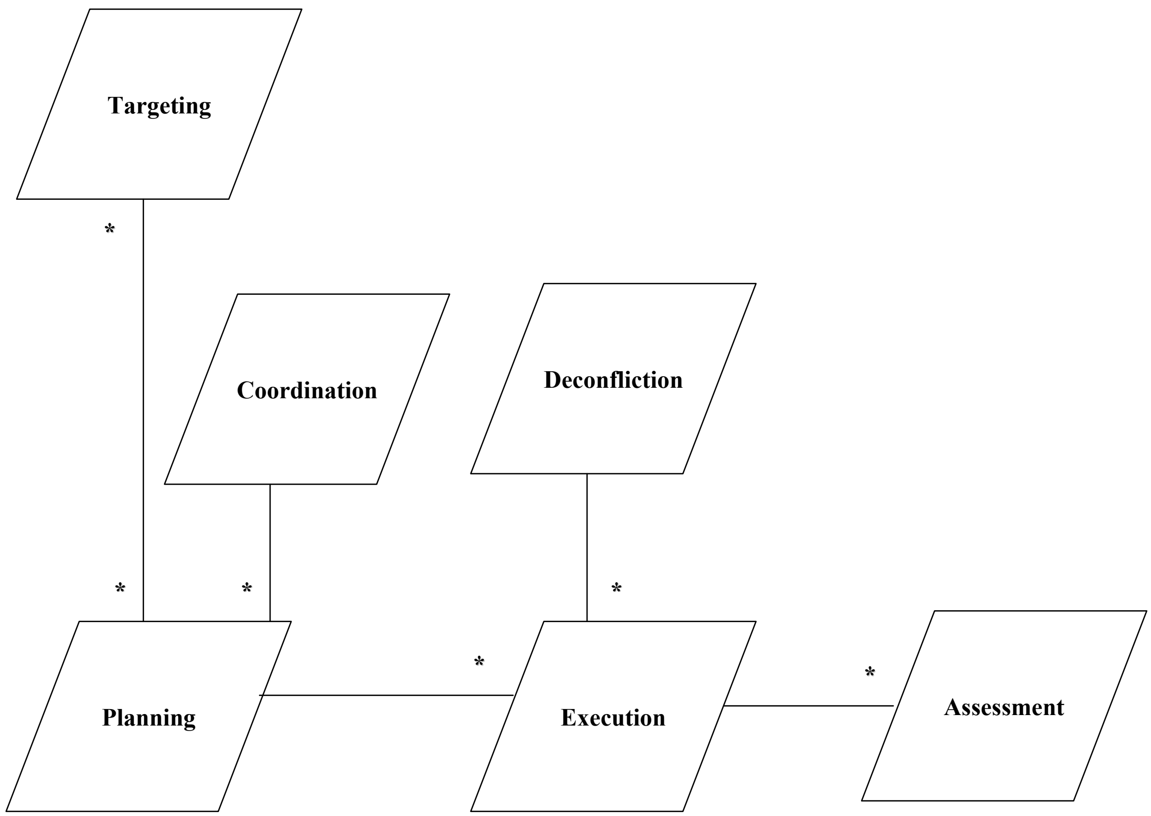



Figure (B-14) - Land Attack Information Model

## C. ORGANIZATION STRUCTURE MODEL

The organization model decomposes the land attack organization from the unified command level to the individual commander aboard a ship or assault element (Figures B-15 - B-21).

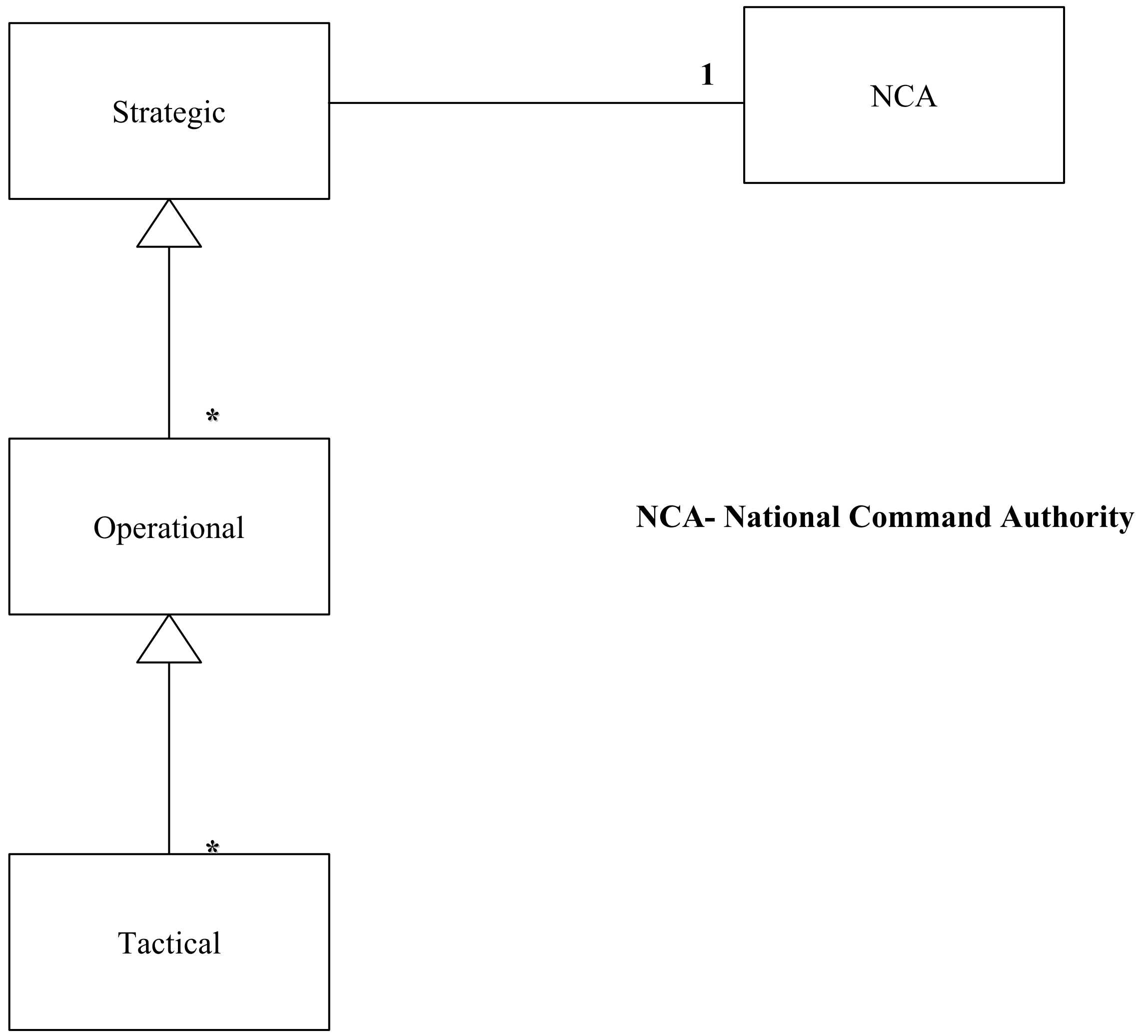



Figure (B-15) – Land Attack Organization Class Diagram

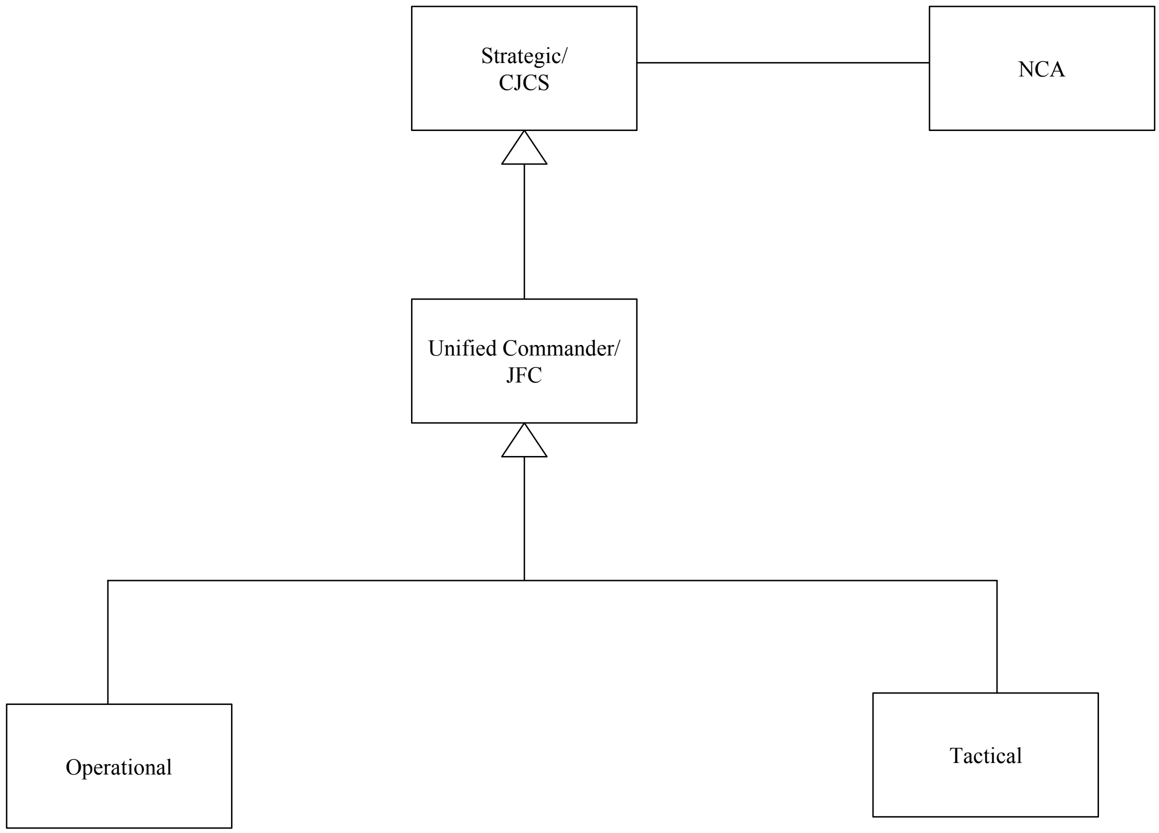
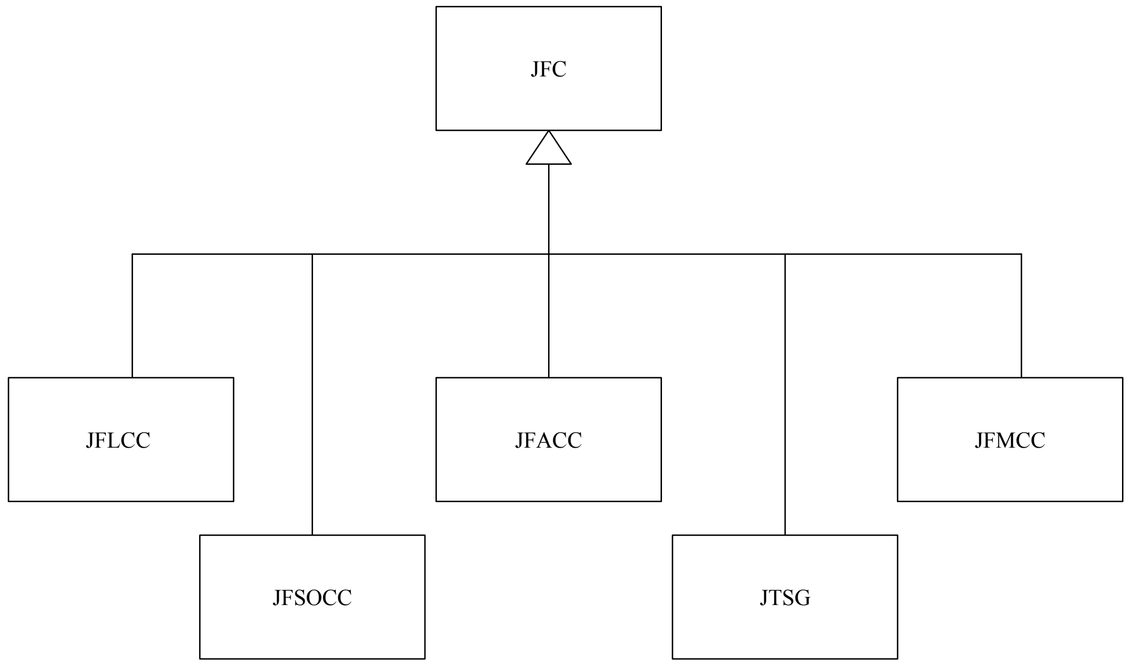
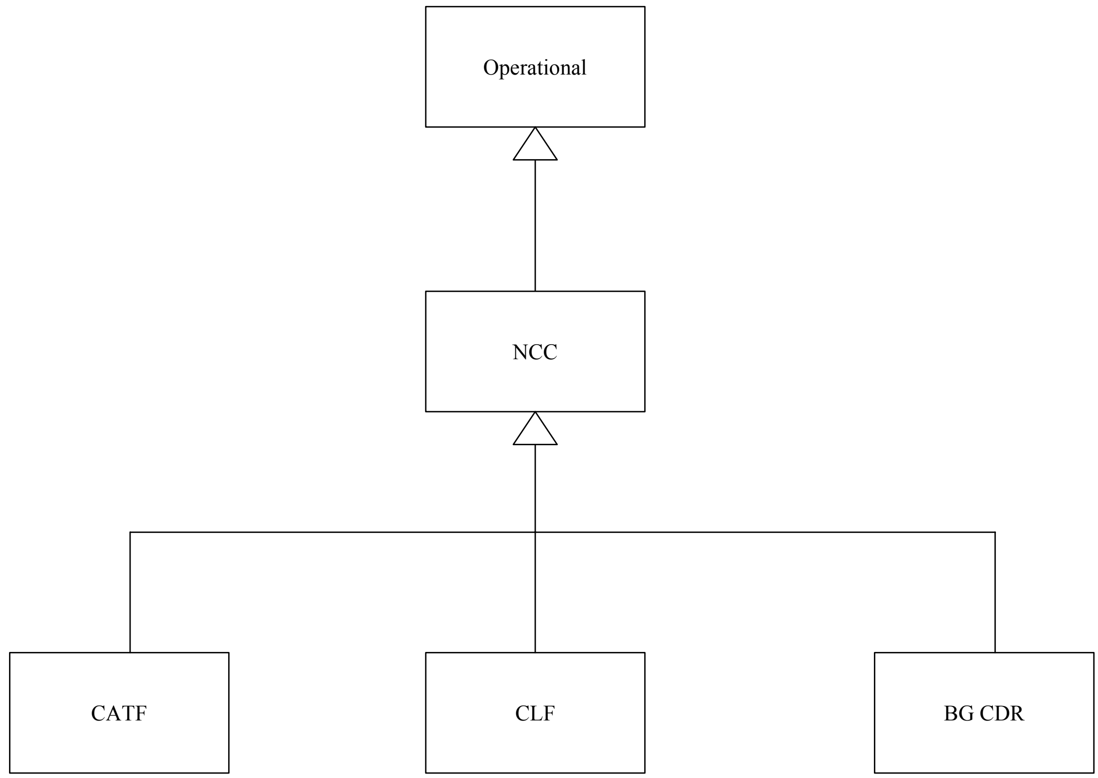



Figure (B-16) – LA Organization



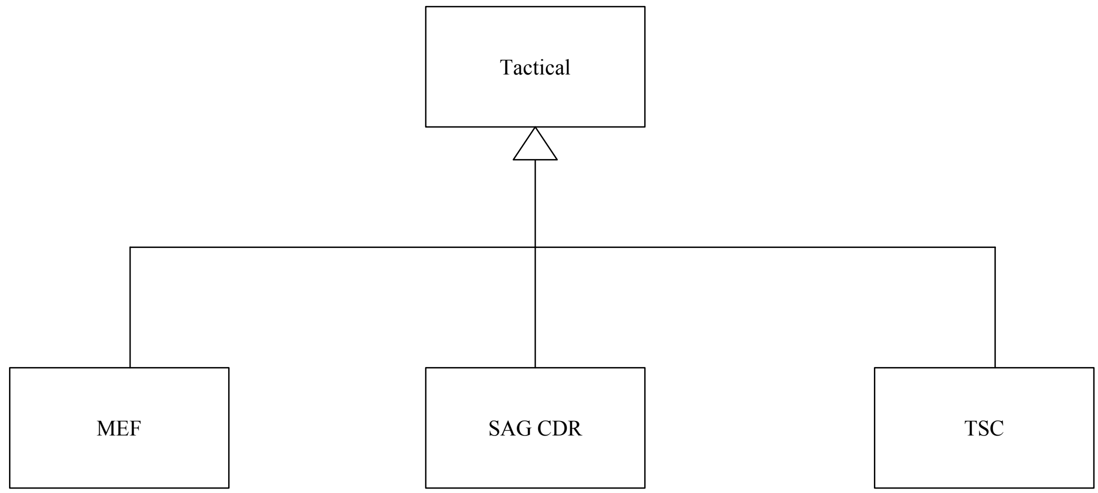

**JFC- Joint Force Commander**
**JFSOCC- Joint Force Special Operations Component Commander**
**JFACC- Joint Force Air Component Commander**
**JTSG- Joint Targeting Steering Group**
**JFMCC- Joint Force Maritime Component Commander**

Figure (B-17) – JFC Organization



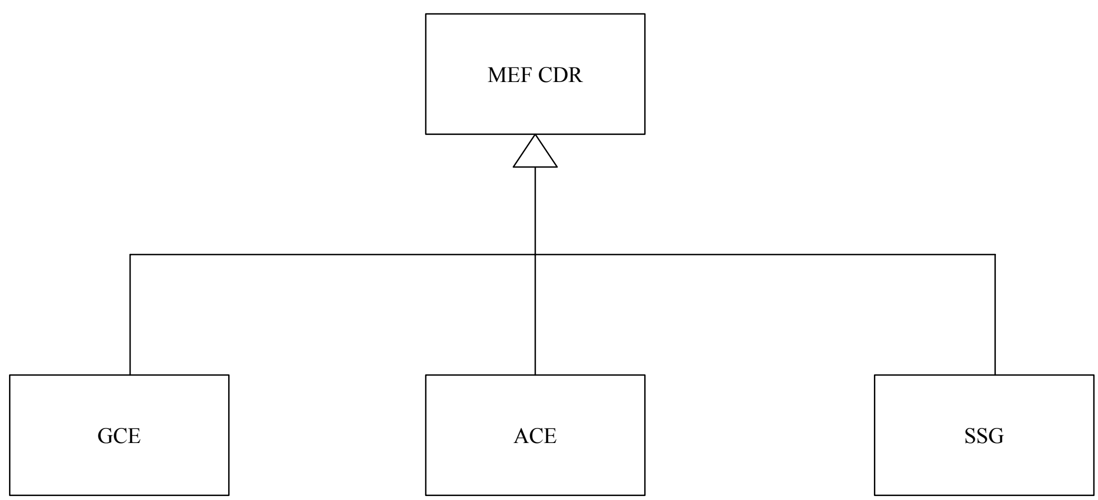

**NCC- Naval Component Commander**
**CATF- Commander Amphibious Task Force**
**CLF- Commander Landing Force**
**BG CDR- Battle Group Commander**

Figure (B-18) – Operational Organization



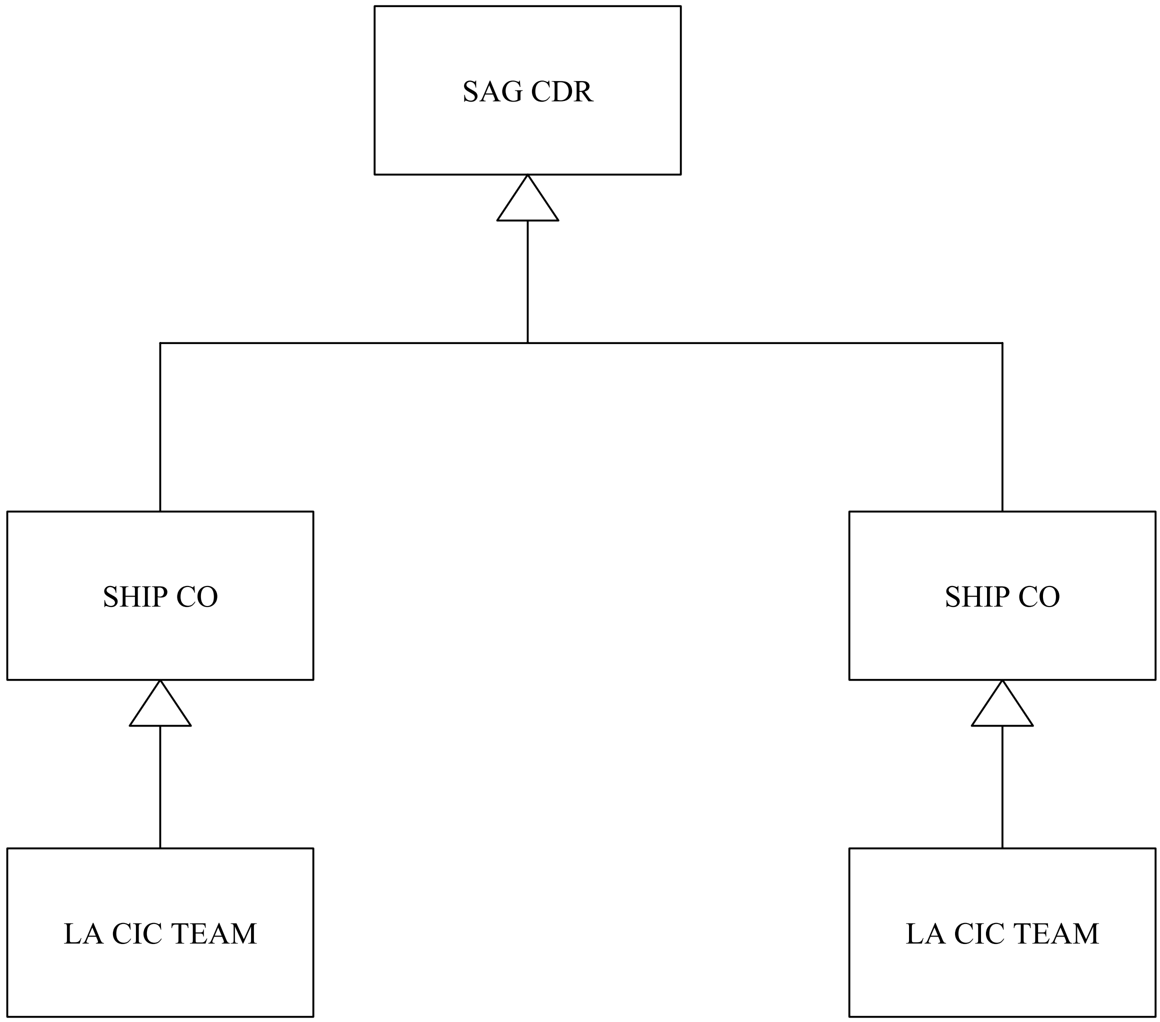

**MEFCDR- Marine Expeditionary Force Commander**
**SAG CDR- Surface Action Group Commander**
**TSC- Tomahawk Strike Coordinator**

Figure (B-19) – Tactical Organization




**MEFCDR- Marine Expeditionary Force Commander**
**GCE- Ground Combat Element**
**ACE- Air Combat Element**
**SSG- Service Support Group**

Figure (B-20) – MEF Organization




**SAGCDR- Surface Action Group Commander**
**LA- Land Attack**
**CIC- Combat Information Center**

Figure (B-21) – SAG Organization

# APPENDIX C - BUSINESS PROCESS VIEW

This appendix provides the models and descriptions of the land attack business rules and process.

## A. BUSINESS RULES

The Eriksson-Penker business notation represents business events as classes and objects in a generalization hierarchy to depict their relationships. The Business Event cycle is modeled as a class-hierarchy. The "Call for Fire" is comprised of ten sub-events, in three tiers. The first tier of the hierarchy consists of the Naval Surface Fire Support and Naval Surface Strike Events. This tier of events specifies the "Call for Fire" method. The second tier consists of events that further specify the "Call for Fire" method. The third tier business events are specific to the NSFS "Call for Fire". These events provide another level of amplification to the methods.

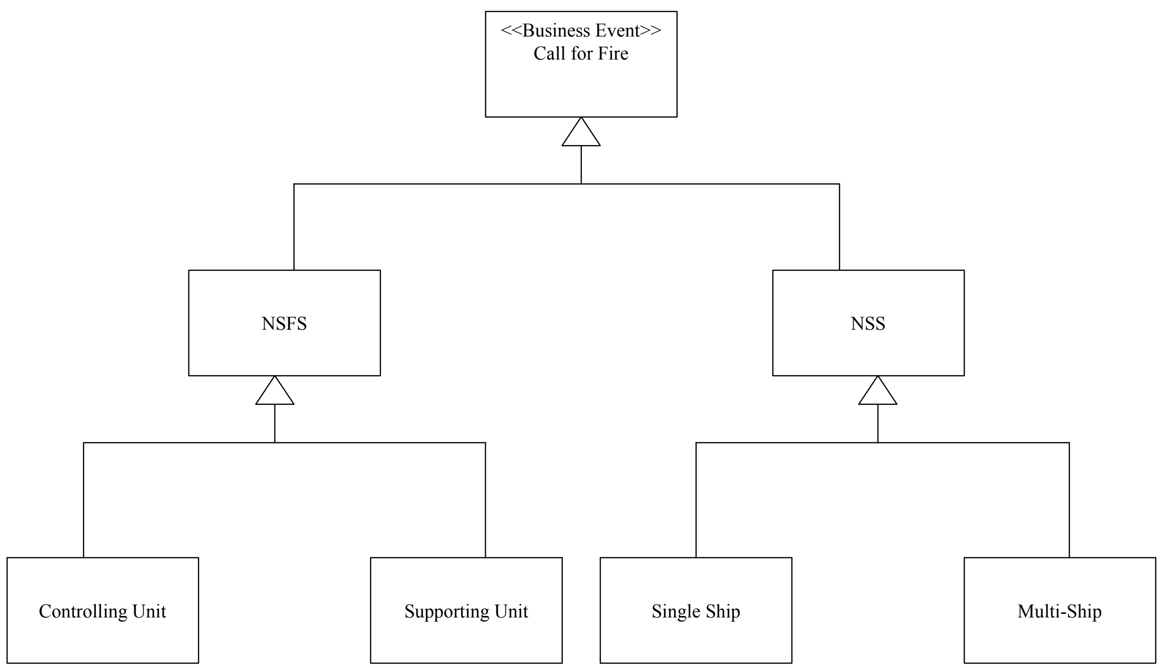



Figure (C-1) - Land Attack Business Events (Part I)

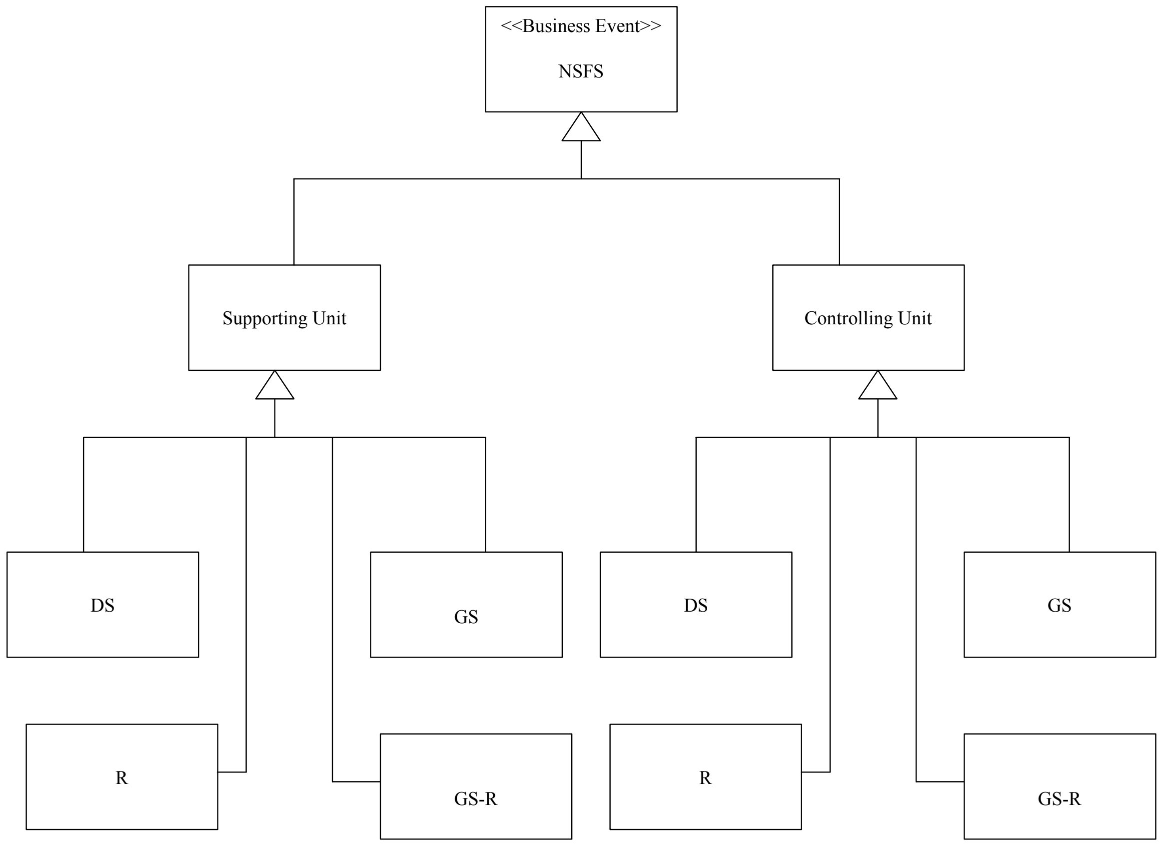



Figure (C-2) - Land Attack Business Events (Part II)

A key portion of the business event cycle is the decision matrix. The business event cycle consists of four decision points and ten rules. Once negotiated, rules are applied to the engagement that control how the engagement process unfolds. Figures C-3 and C-4 graphically depict this relationship.

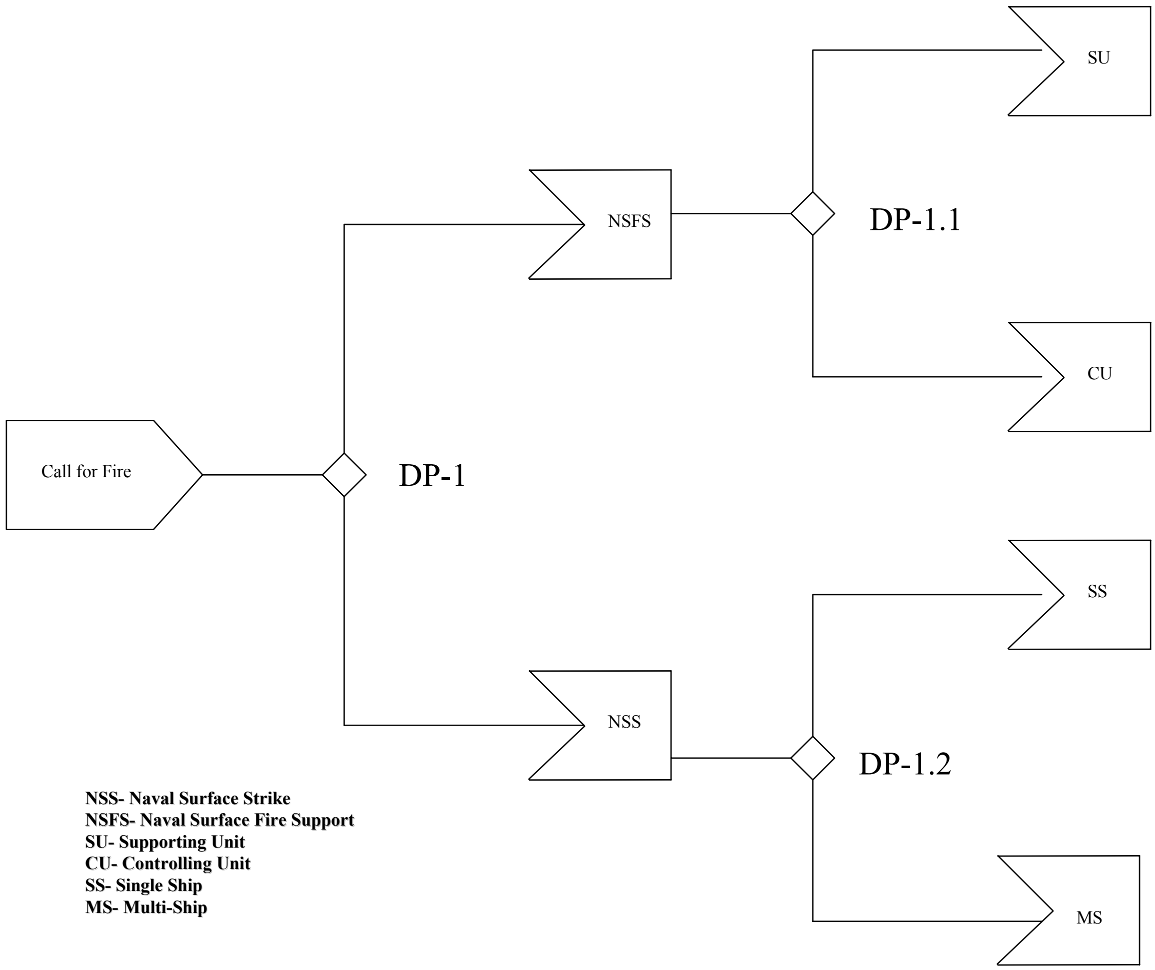



Figure (C-3) - Land Attack Decision-Points (Part I)

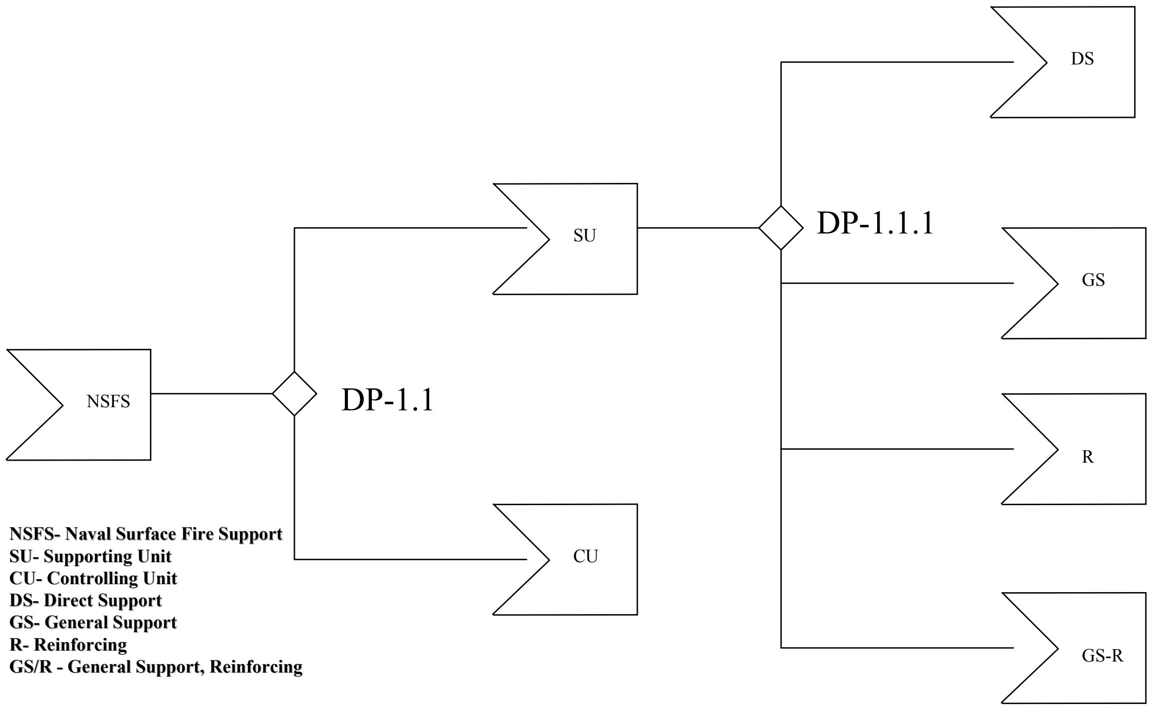



Figure (C-4) - Land Attack Decision-Points (Part II)

Table C-1 relates decision-points to the rule sets. The decision matrix is explained in the text following the matrix.

| ***Business Event*** | ***Decision Point*** | ***Rule Set*** |
|---|---|---|
| Call For Fire | 1 | |
| NSS | 2 | A |
| Single Ship | | E |
| Multi-Ship | | F |
| NSFS | 2 | B |
| Supporting Unit | | C |
| Coordinating Unit | | D |
| DS | 3 | G |
| GS | 3 | H |
| R | 3 | I |
| GS-R | 3 | J |

Table (C-1) – LA Business Event/Rule Set Matrix

1. Decision Point: DP-1

   Title: Call For Fire Type

   Criteria: Is the engagement in support of maneuvering forces?

   Result: Yes, then generate NSFS business event.

   No, then generate NSS business event.

2. Rule Set: A

   Title: Naval Surface Strike Rules

   Description: Naval Surface Strike is conducted independently of maneuvering forces. Platforms conducting NSS must be capable of planning, targeting, controlling, coordinating, deconflicting, executing and assessing own-ship fires as a single platform or group of platforms. Platforms receive mission orders, commander's guidance, and rules of engagement from higher authority with no higher-level on-scene commander available in the area of operation.

3. Rule Set: B

   Title: Naval Surface Fire Support Rules

   Description: Naval Surface Fire Support will be conducted in support of maneuvering forces ashore. Platforms conducting NSFS must be capable of receiving, processing, and controlling calls for fire from fire support coordination agencies and forward observers ashore. Platforms will operate in a support or control role.

4. Decision Point: DP-1.1

   Title: NSFS Type

   Criteria: Is the platform individually receiving firing orders from a fire support coordination agency?

   Is the platform directing and controlling the fires of multiple platforms?

   Result: If platform is individually receiving firing orders from a fire support coordination agency, then the platform is operating as a supporting unit.

   If the platform is directing and controlling the fires of multiple platforms, then the platform is operating as a controlling unit

5. Rule Set: C

   Title: Supporting Unit Rules

Description: Supporting units receive calls for fire from fire support coordination agencies and forward observers. Calls for fire are executed in accordance with the rules of fire support

6. Rule Set: D

   Title: Controlling Unit Rules

   Description: Controlling units direct and control fires of multiple platforms. Controlling units receive calls for fire from fire support coordination agencies, process the requests in accordance with commander's intent, and assign one or more platforms assigned the requested fires.

7. Decision Point: DP-1.2

   Title: NSS Type

   Criteria: Is the firing platform operating independently or as a part of a multiple platform group?

   Result: If the platform is operating independently, then platform is operating in the single ship role.

   If the platform is operating as part of a multiple ship group, then the platform is operating in the multi-ship role.

8. Rule Set: E

   Title: Single Ship Rules

   Description: Platforms operating in the single ship mode must be able to plan, target, control, coordinate, deconflict, execute, and assess own-ship fires. The single ship will receive mission orders, commander's guidance, and rules of engagement from higher authority. The single unit must be able to execute missions using organic and inorganic intelligence, surveillance, and reconnaissance.

The platform will have the authority to determine which targets to engage, with what weapons, and to what degree.

9. Rule Set: F

   Title: Multi-Ship Rules

   Description: Platforms operating in multi-ship role must be able to conduct single-ship missions. In addition, platforms must be able to complete those tasks for a group of platforms operating in concert.

10. Decision Point: DP-1.1.1

    Title: Support Type

    Criteria: Is the unit providing fire support to the force to a specific unit?

    Is the unit providing fire support to the force as a whole?

    Is the unit providing fires to a unit that is providing fire support to a specific unit?

    Is the unit providing fire support to the force as a whole and providing fires to a unit that is providing fire support to a specific unit?

    Result. If the unit is providing fire support to a specific unit, then the unit is providing direct support.

    If the unit is providing fire support to the force as a whole, then the unit is providing general support.

    If the unit is providing fires to a unit that is providing fire support to a specific unit, then the unit is reinforcing.

    If the unit is providing fire support to the force as a whole and providing fires to a unit that is providing fire support to a specific unit, then the unit is providing general support-reinforcing.

11. Rule Set: G

Title: DS Rules

Description: Direct Support (DS) missions require a unit to provide close supporting fires to a specific unit.

12. Rule Set: H

    Title: GS Rules

    Description: General Support (GS) missions require a unit to provide support to the force as a whole.

13. Rule Set: I

    Title: R Rules

    Description: Reinforcing (R) missions require a unit to provide fires to a unit that is providing direct support to another unit. The DS unit will use the fires of the reinforcing unit to augment its support to the supported unit.

14. Rule Set: J

    Title: GS-R Rules

    Description: General Support-Reinforcing missions require a unit to provide general support to the force as a whole, while providing reinforcing fires to a unit acting in direct support of a supported unit as its secondary priority.

## B. BUSINESS PROCESS

Targets are created and destroyed in the "engagement" process through a series of sub-processes and activities. For the purposes of the development of the "engagement" process, "engagement" has been considered a macro-process consisting of the elements of the time-critical strike decision cycle. The elements (detect, decide, engage, assess) have been considered processes (Figures C5 and C6). They have been decomposed into sub-processes and activities. Each process is listed below in terms of sub-processes, activities, input objects, supply objects, control objects, goal objects, output objects, and a description of the process.

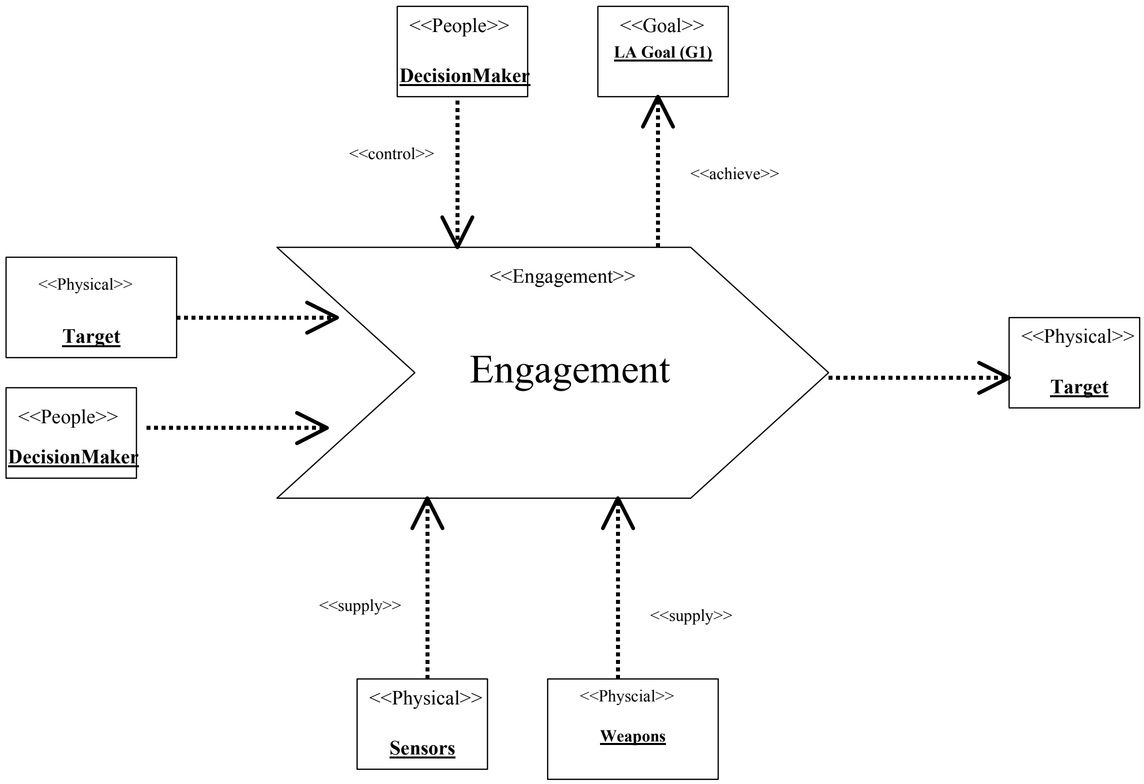



Figure (C-5) - Land Attack Activity Diagram

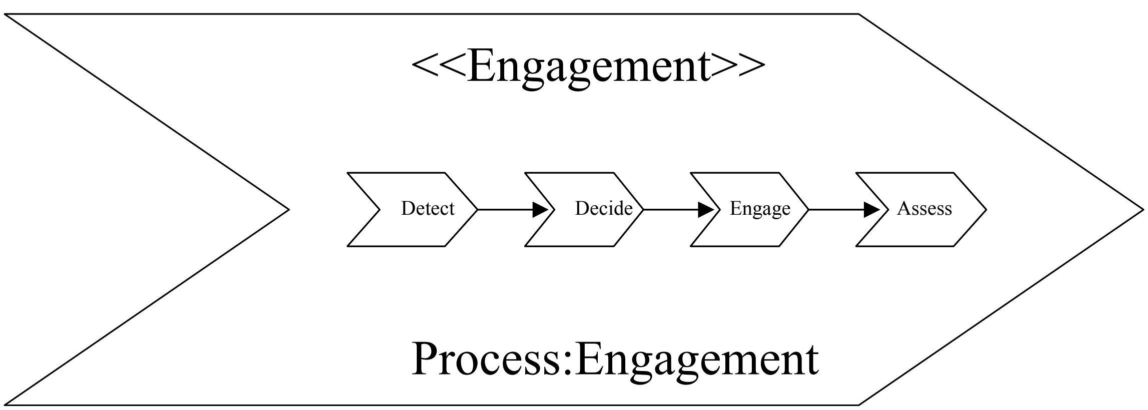



Figure (C-6) - Land Attack Process Diagram

1. Detect

**Process**: Detect (P.1) (**Figures C7-13**)

**Associated Sub-Processes**: Cue (P.1.1), Assess (P.1.2), Task-Collect (P.1.3), Exploit (P.1.4), Nominate (P.1.5)

**Associated Activities**: Select Cueing Criteria (A.1.1.), Fuse and Correlate Sensor Data (A.1.2), Develop Collection Plan (A.1.3), Disseminate Updated Collection Guidance (A.1.3.1), Target Confirmation (A.1.4), Target Information Sharing (A.1.5)

**Input Object**: Physical Target

**Supply Object**: Sensor

**Control Object:** Decision-Maker

**Goal Object:** Dynamic Battle-Manangement

**Output Object:** Target Information

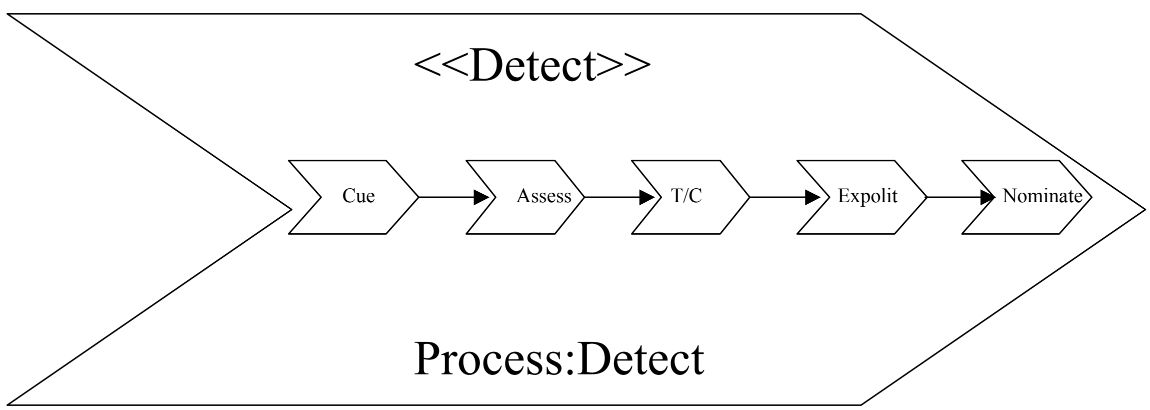



Figure (C-7) - Detect Process

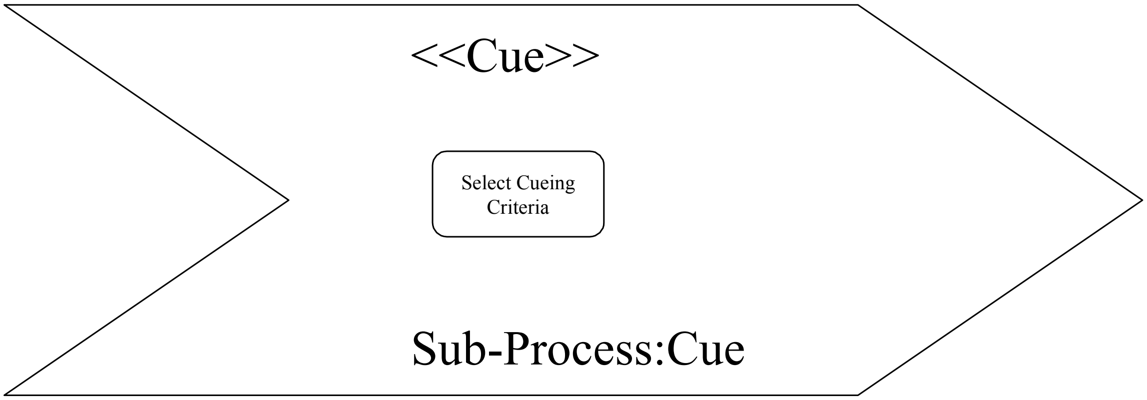



Figure (C-8) - Cue Sub-Process

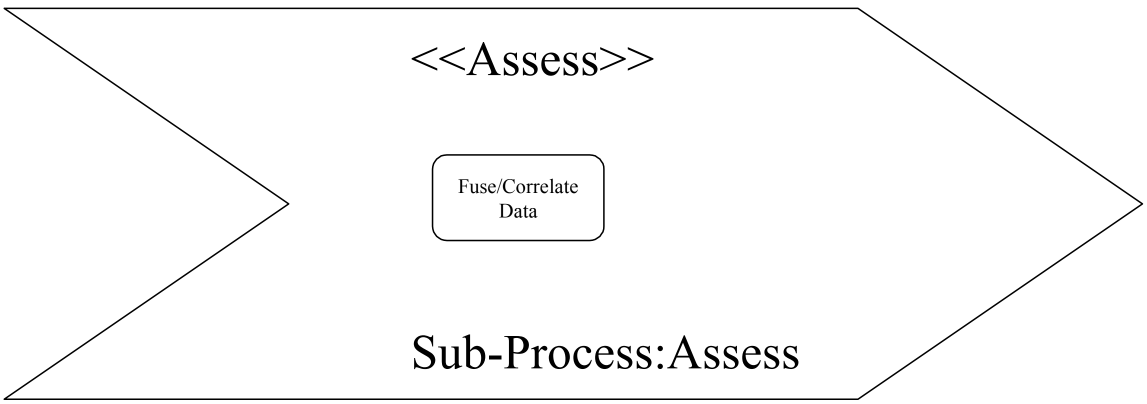



Figure (C-9) - Assess Sub-Process

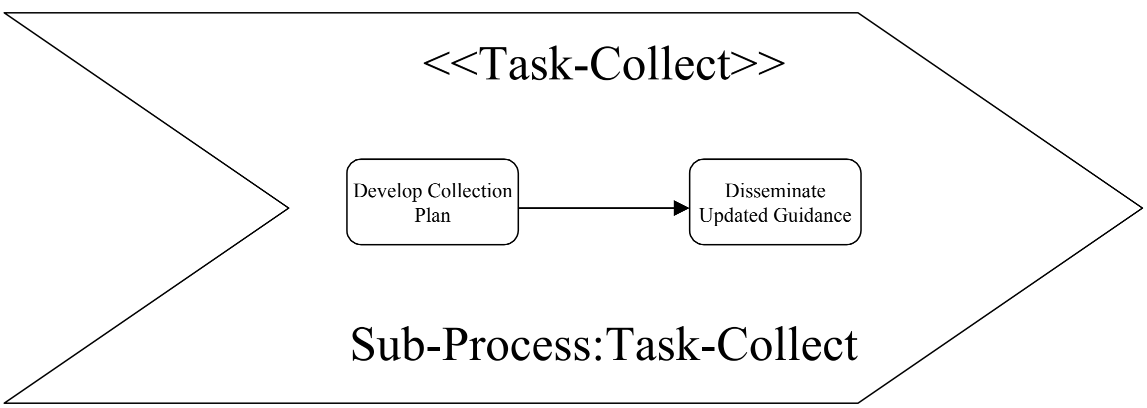



Figure (C-10) - Task-Collect Sub-Process

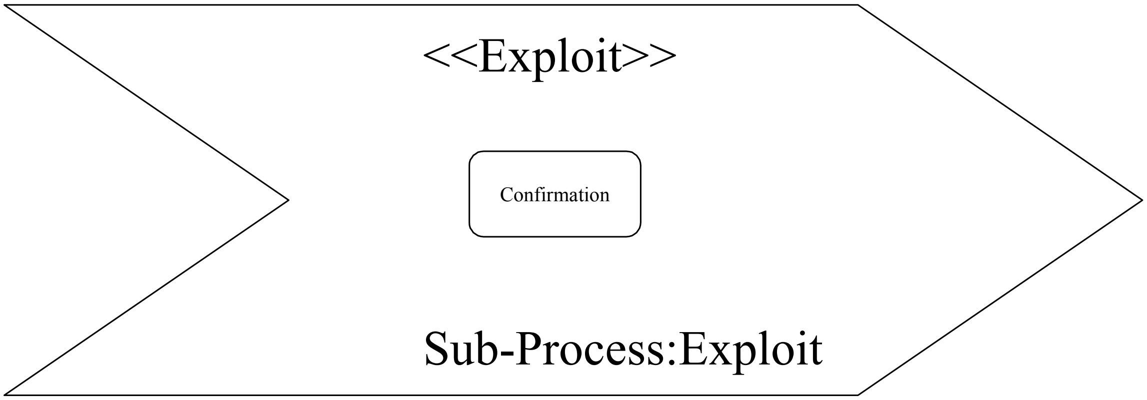



Figure (C-11)- Exploit Sub-Process

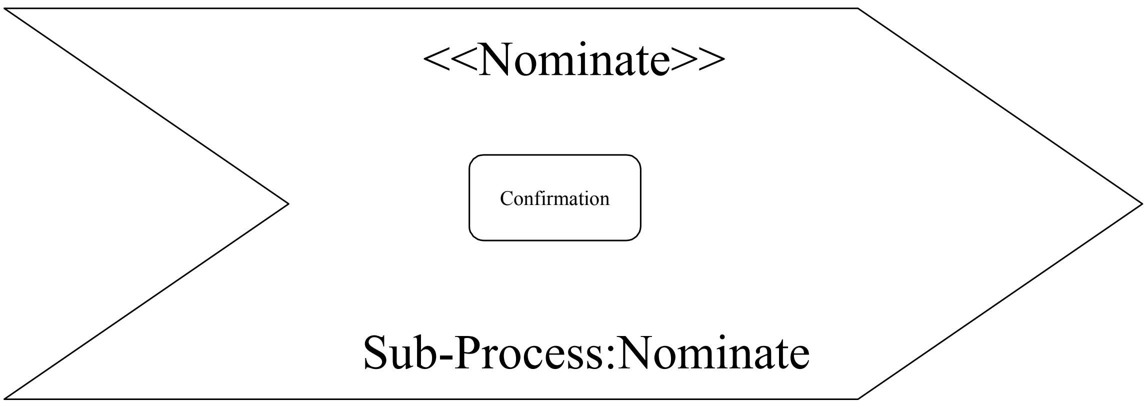



Figure (C-12) - Nominate Sub-Process

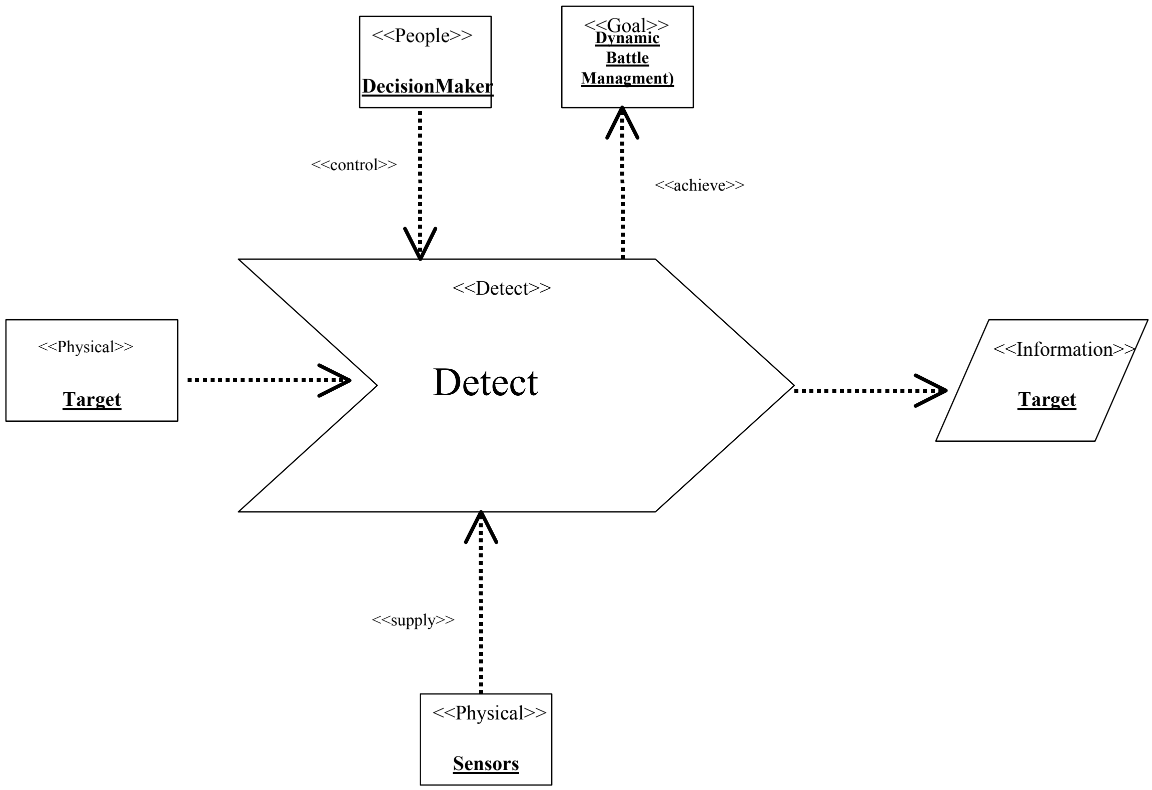



Figure (C-13) - Detect Activity Diagram

2. Decide

**Process**: Decide (P.2) (**Figures C14-22**)

**Associated Sub-Processes**: Prioritize (P.2.1), Weapons-Target-Platform Match (P.2.2), Decide (P.2.3), Coordinate and Deconflict (P.2.4), Update Mission Planning (P.2.5), Weaponeering (P.2.6), Task (P.2.7)

**Associated Activities**: Establish Commander's Guidance (A.2.1), Establish Target List (A.2.1), Evaluate Target List (A.2.1), Review Target (A.2.2), Review Weapon (A.2.2), Review Platform (A.2.2), Consult Commander's Guidance (A.2.3), Consult ROE (A.2.3), Execute Decision (A.2.3), Deconflict Strike (A.2.4), Synchronize Strike (A.2.4), Update Target (A.2.5), Update Mission (A.2.5), Specify Aim-points (A.2.6), Specify Weapon (A.2.6), Specify Platform (A.2.7)

**Input Objects**: Target Information

**Supply Objects**: Decision -Maker, Target Information

**Controlling Objects**: Decision-Maker

**Goal Object**: Execution

**Output Object**: Target Information

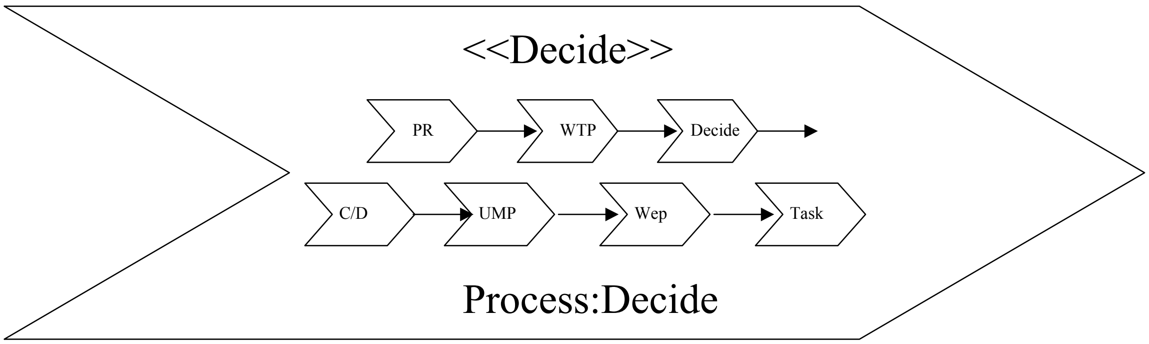



Figure (C-14) - Decide Process Diagram

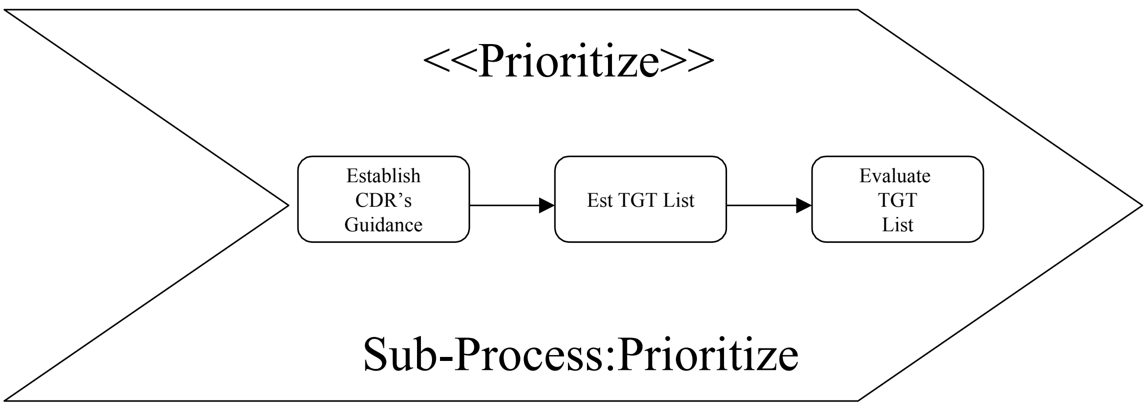



Figure (C-15) - Prioritize Sub-Process

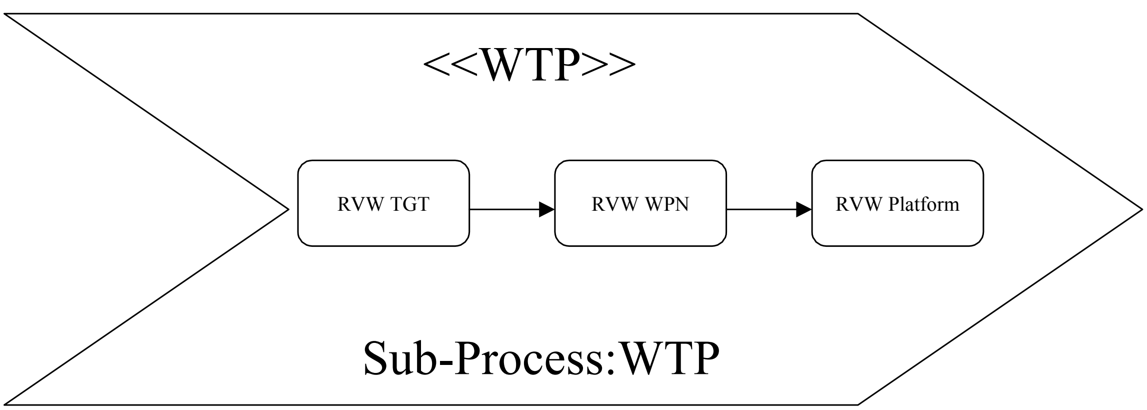



Figure (C-16) - Weapons-Target-Platform Matching Sub-Process

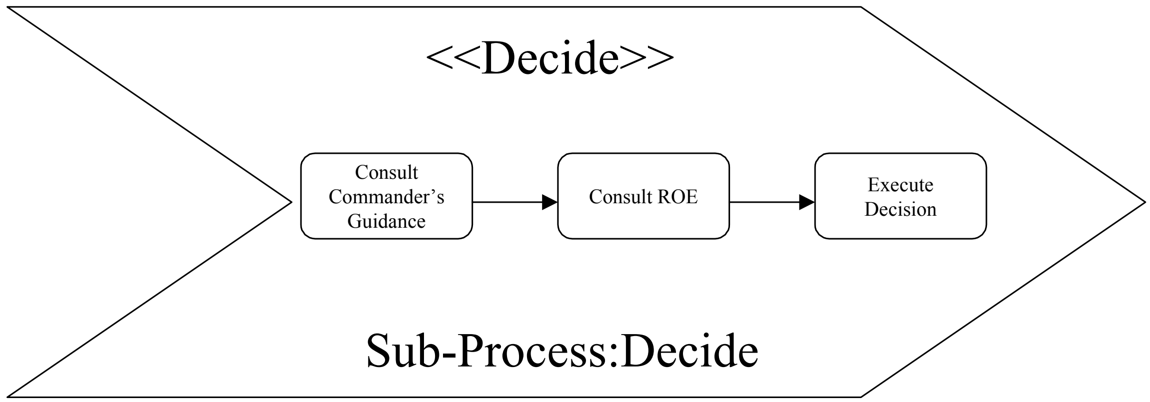



Figure (C-17) - Decide Sub-Process

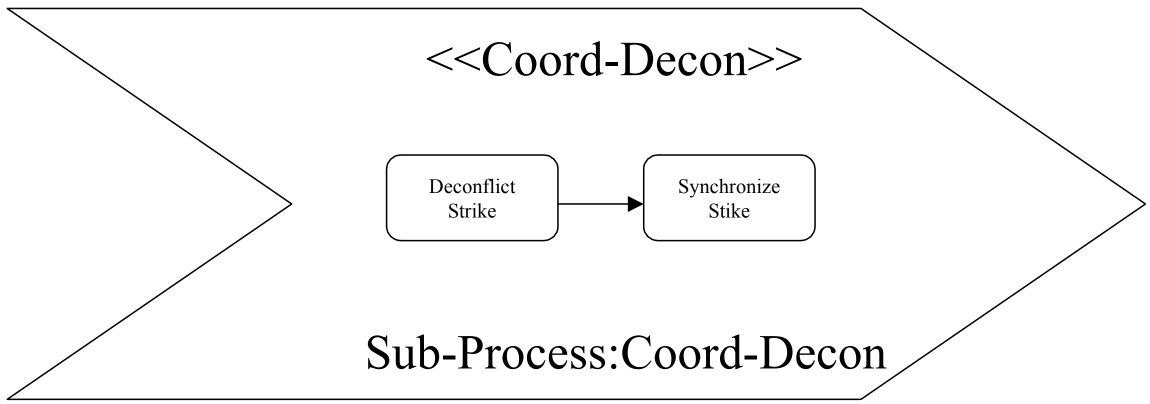



Figure (C-18) - Coordinate-Deconflict Sub-Process

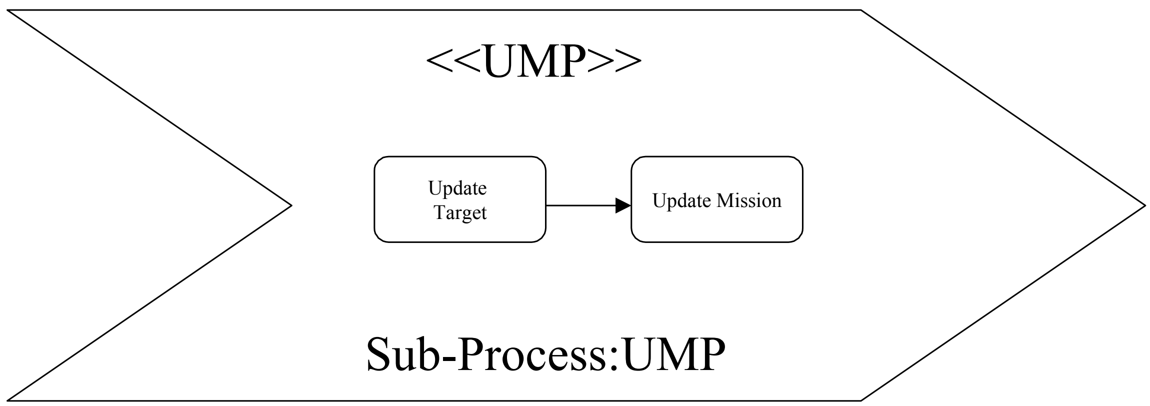



Figure (C-19) - Update Mission Planning Sub-Process

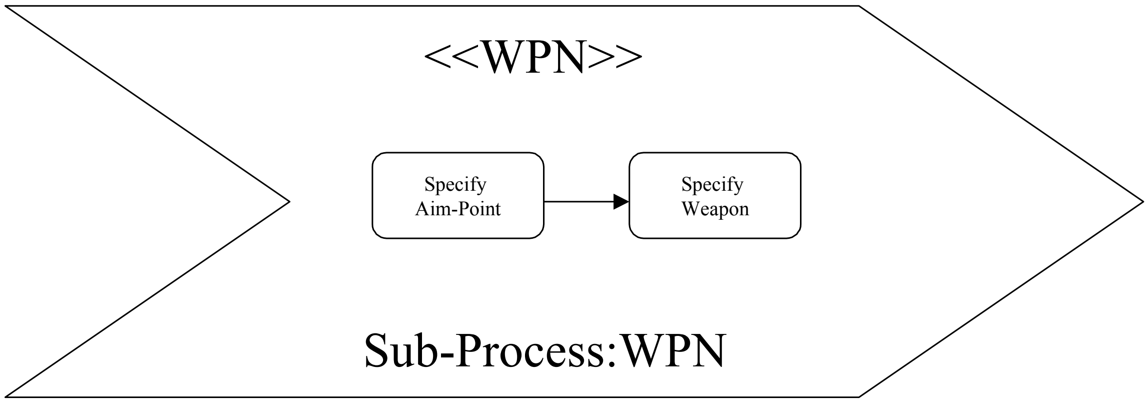



Figure (C-20) - Weaponeering Sub-Process

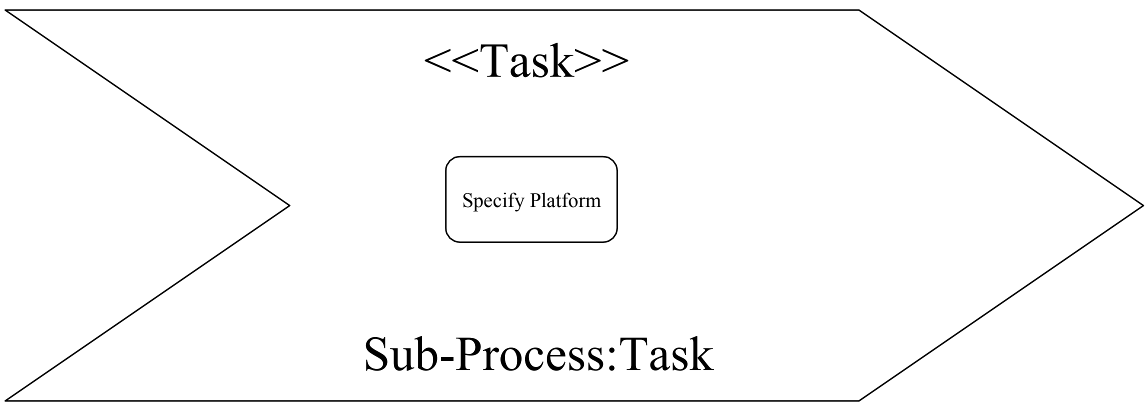



Figure (C-21) - Task Sub-Process

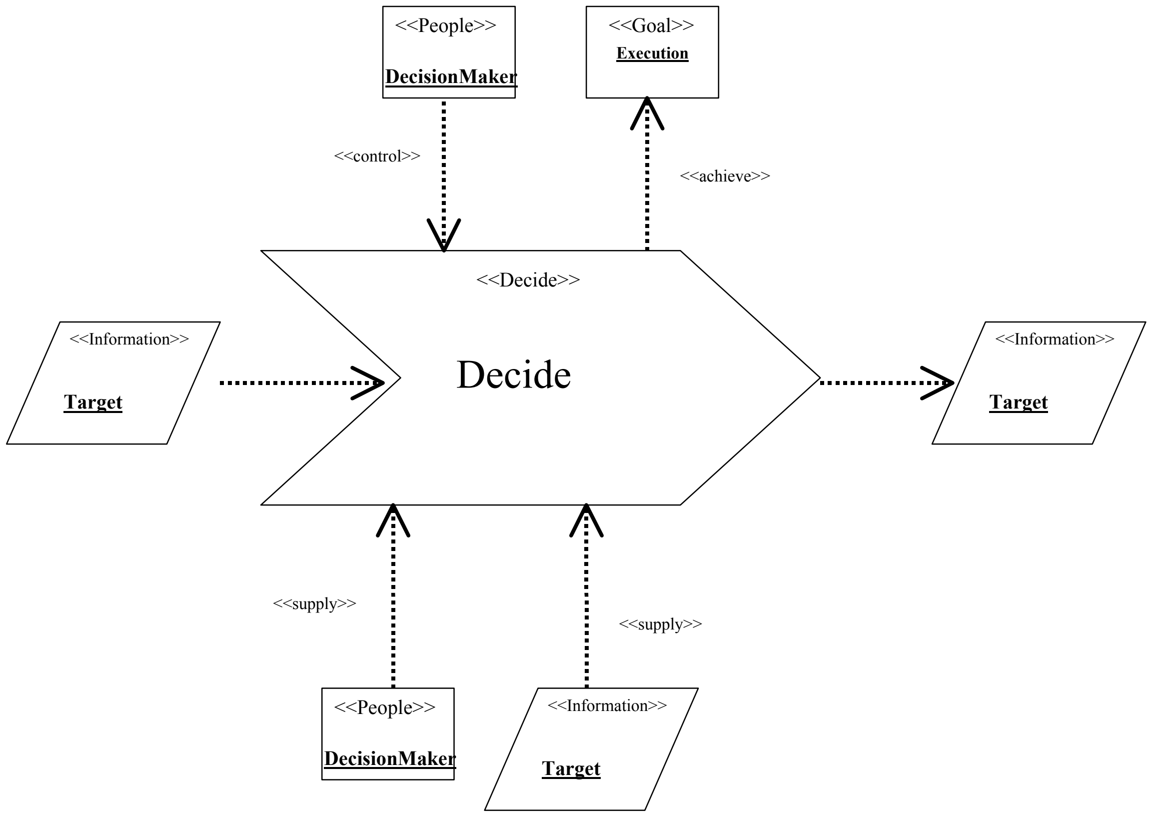



Figure (C-22) - Decide Activity Diagram

3. Engage

**Process**: Engage (P.3) (**Figures C23-24**)

**Associated Sub-Processes**: Execution (P.3.1), Plan for Combat Assessment (P.3.2)

**Associated Activities**: None

**Input Object**: Target Information

**Supply Object**: Weapon, Sensor

**Control Object:** Decision-Maker

**Goal Object:** Firepower

**Output Object:** Physical Target

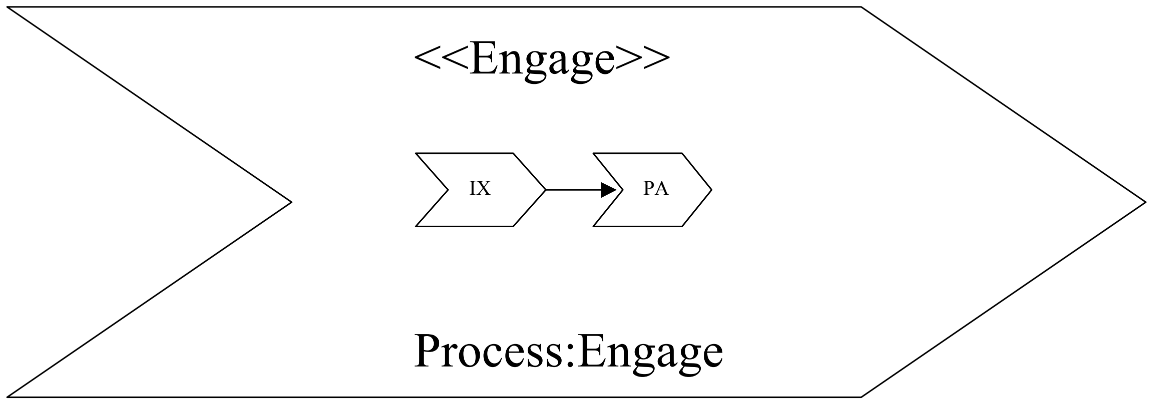



Figure (C-23) - Engage Sub-Process

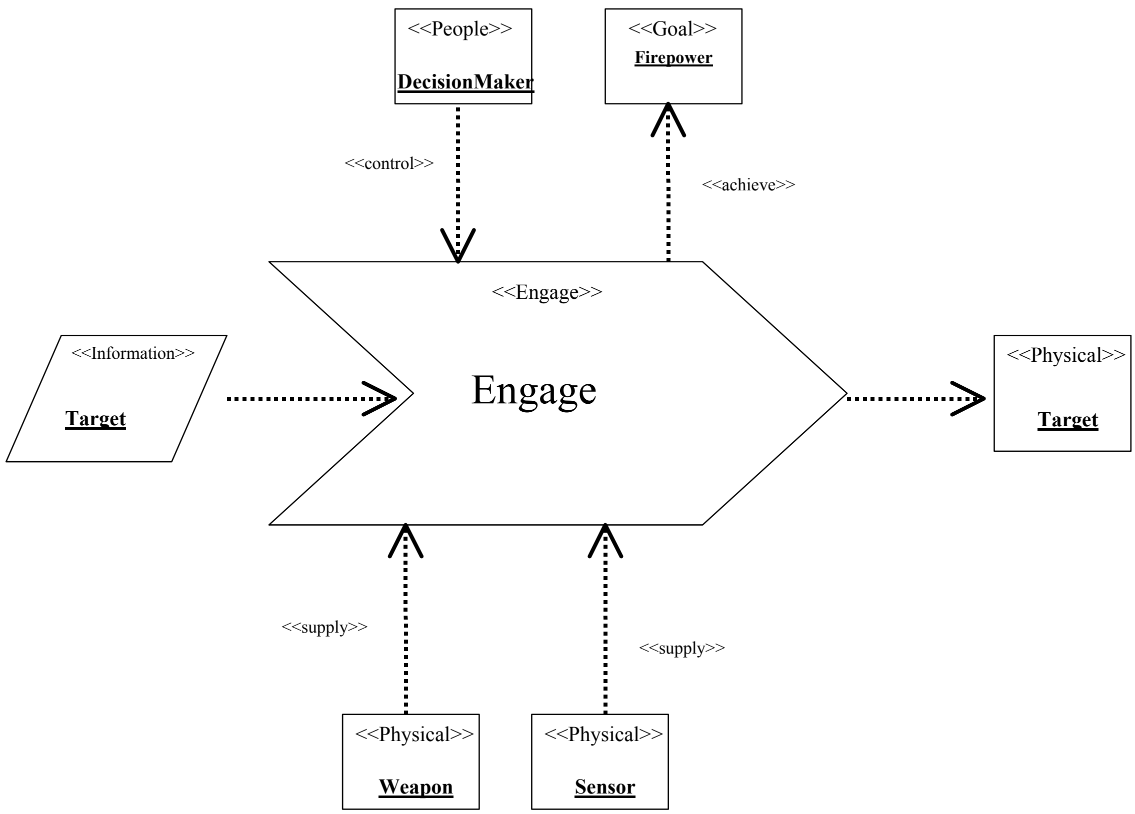



Figure (C-24) - Engage Activity Diagram

4. Assess

**Process**: Assess (P.4) (**Figures C25-30**)

**Associated Sub-Processes**: Cue (P.4.1), Assess (P.4.2), Task-Collect (P.4.3), Exploit (P.4.4), Nominate (P.4.5)

**Associated Activities**: Select Cueing Criteria (A.4.1.), Fuse and Correlate Sensor Data (A.4.2) , Develop Collection Plan (A.4.3), Disseminate Updated Collection Guidance(A.4.3.), Target Confirmation (A.4.4), Target Information Sharing (A.4.5)

**Input Object**: Physical Target

**Supply Object**: Sensor

**Control Object:** Decision-Maker

**Goal Object:** Dynamic Battle-Management

**Output Object:** Target Information

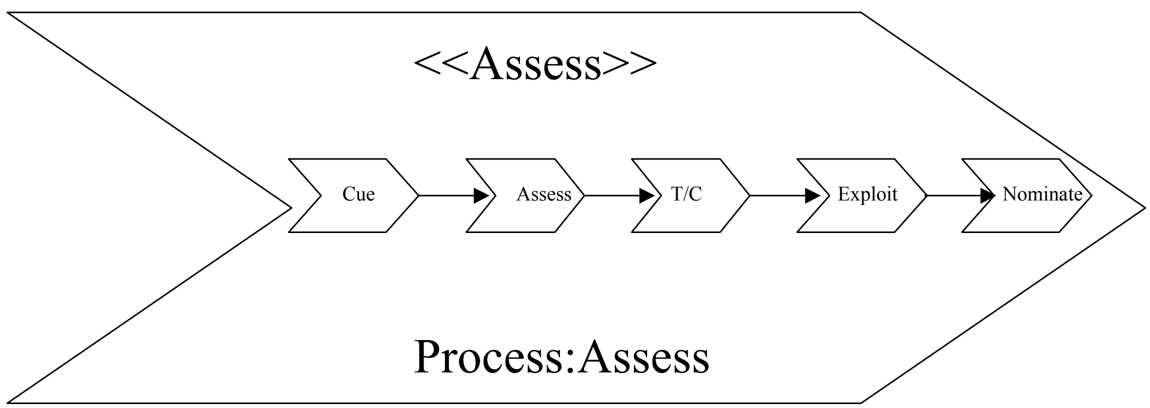



Figure (C-25) -Assess Process

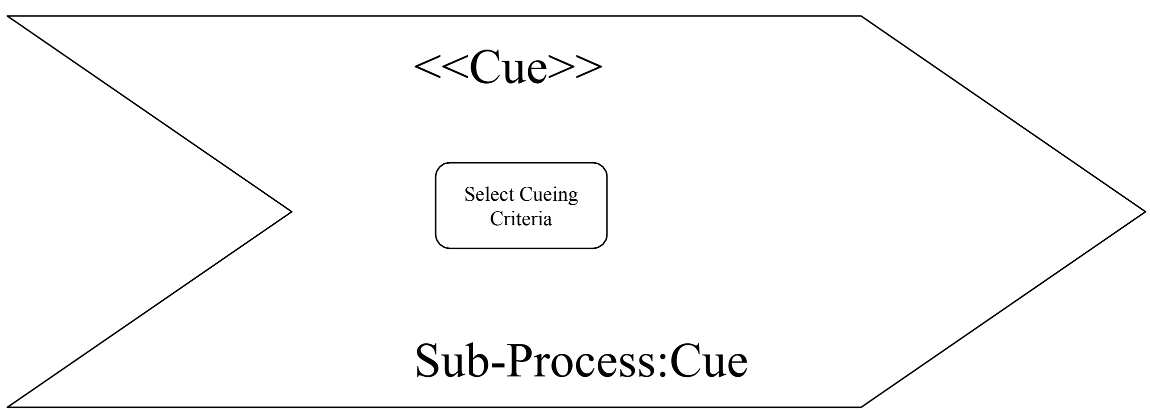



Figure (C-26) - Cue Sub-Process

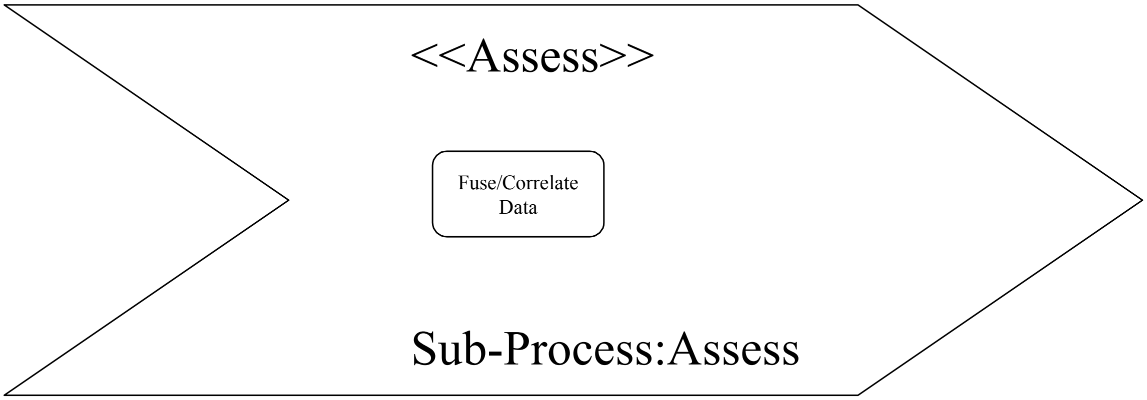



Figure (C-27) - Assess Sub-Process

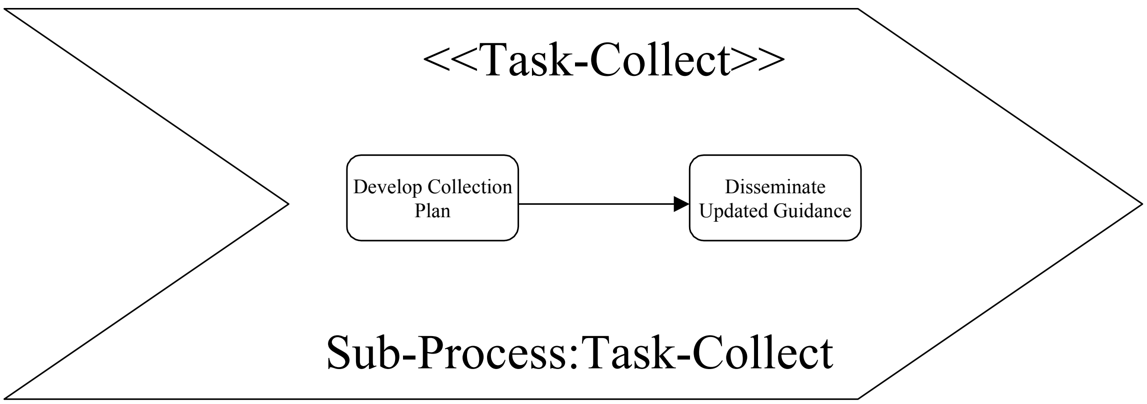



Figure (C-28) - Task-Collect Sub-Process

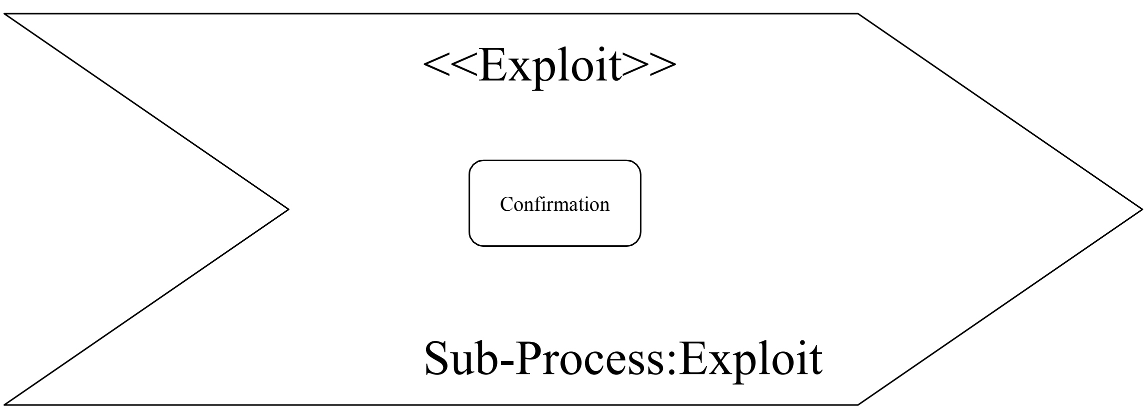



Figure (C-29) - Exploit Sub-Process

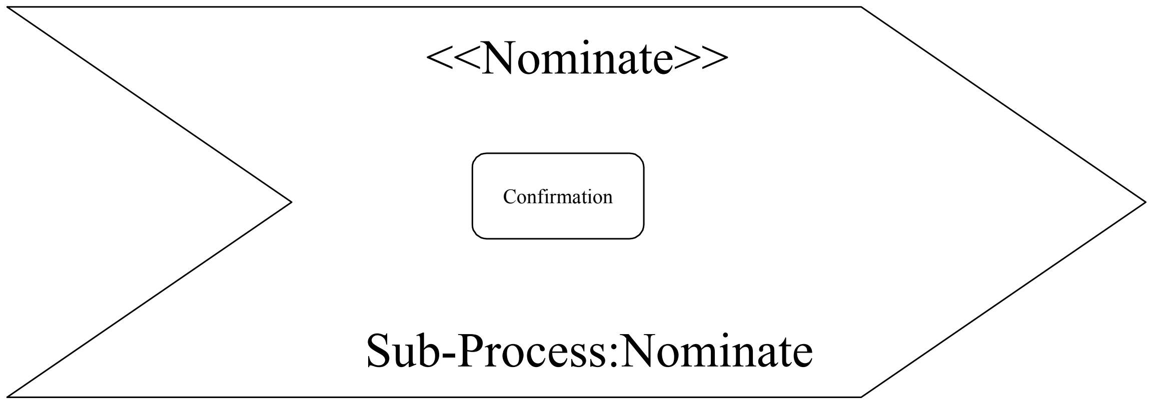



Figure (C-30) - Nominate Sub-Process

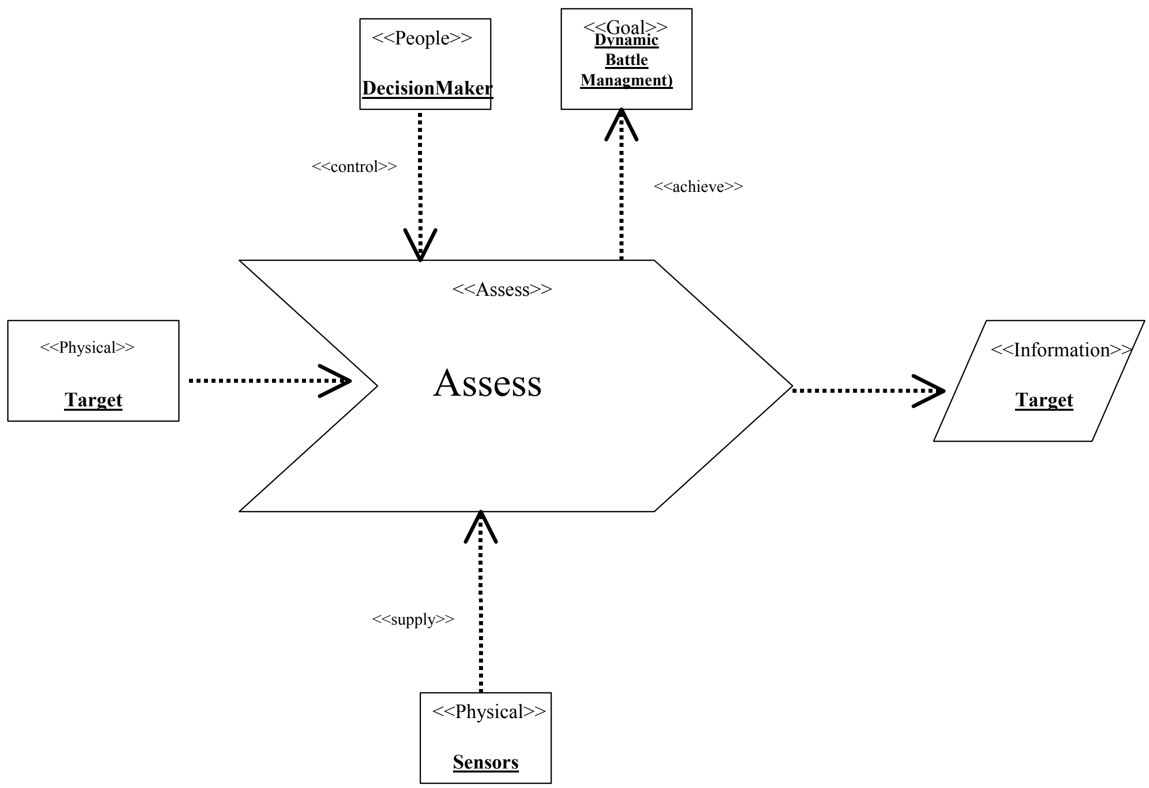



Figure (C-31) - Assess Process Activity Diagram

# APPENDIX D - BUSINESS BEHAVIOR VIEW

Business behavior is depicted using assembly line modeling and systems analysis. Appendix D provides a description of the assembly line models and reference packages.

## A. PROCESS-RESOURCE

Process-resource behavior is captured in assembly line modeling. The reference packages represent behavior between the engagement process and the network of resources. Each reference package is presented along with its assembly line diagram.

### 1. Decide

*Reference Package 1 (**Figure D-1**)*

1. Reference: Establish Commander's Guidance (R1.1)

Type: Write

Package Referenced: Decision-Maker

Description: Land attack operations are conducted in accordance with established commander's guidance.

2. Reference: Establish Target List (R1.2)

Type: Write

Package Referenced: Target - Information

Description: The target list is established with relative priority. These are the targets, which enter the engagement process and the target acquisition to weapon-delivery time line.

3. Reference: Establish Attack Guidance Matrix (R1.3)

Type: Write

Package Referenced: Target-Information

Description: An established attack guidance matrix provides decision makers a tool to use when planning land attack engagements.

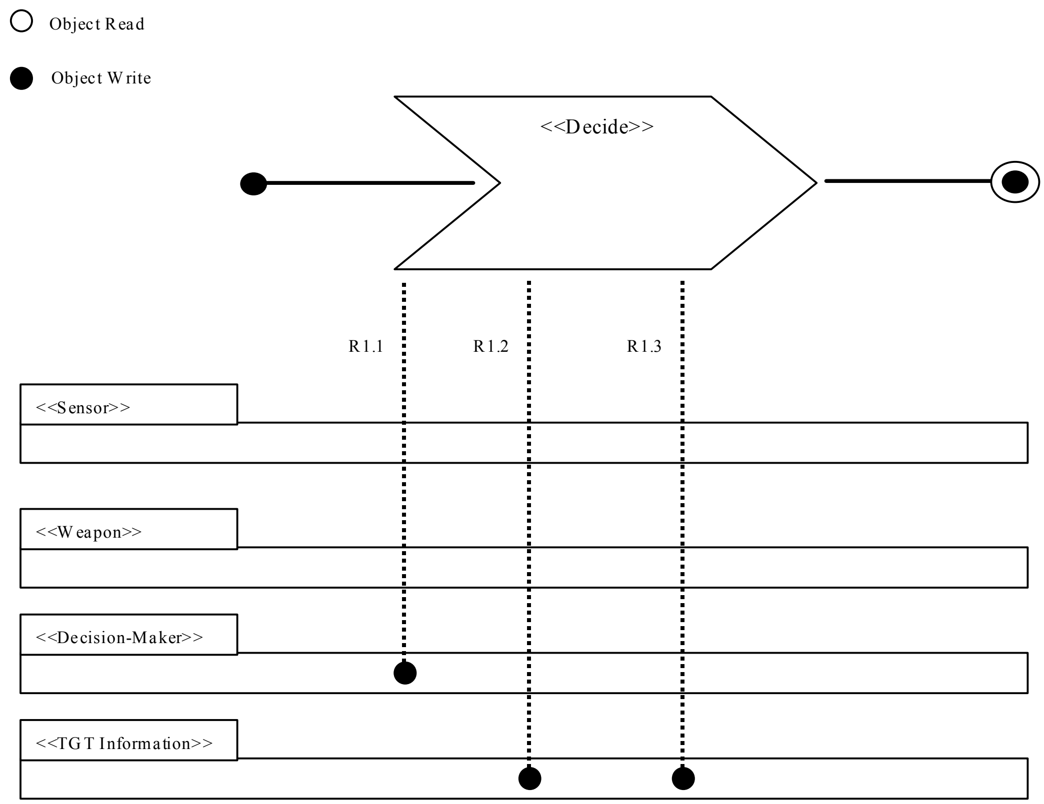



Figure (D-1) - "Decide" Assembly Line Diagram

2. Detect

***<u>Reference Package 2 (Figure D-2)</u>***

<u>1. Reference: Set Collection Priorities (R2.1)</u>

Type: Write

Package Referenced: Target-Information

Referenced By: Decision-Maker

Description: Collection priorities must be disseminated to all decision makers. Tasking and collecting target data will be based upon the priorities set by decision makers with this reference

<u>2. Reference: Task-Collect (R2.2)</u>

Type: Write

Package Referenced: Sensor

Description: Sensors will be tasked to collect target data based upon collection priorities.

<u>3. Reference: Fuse - Correlate (R2.3)</u>

Type: Read

Package Referenced: Sensor

Description: Raw target data is read from the sensor package and evaluated.

<u>4. Reference: Target Confirmation (R2.4)</u>

Type: Write

Package Referenced: Target Information

Discussion: Decision makers, using the fused and correlated target information, confirm the target information as the desired targets for use in the engagement process.

<u>5. Reference: Target Information Sharing (R2.5)</u>

Type: Write

Package Referenced: Target-Information

Description: The target confirmation information is placed in the target information package. Any decision-maker may reference this target information during the engagement process.

<u>6. Reference: Update Collection Priorities (R2.6)</u>

Type: Write

Package Referenced: Target-Information

Referenced By: Decision-Maker

Description: Collection priorities are continually updated throughout the assault. As the operational and tactical situation changes, collection priorities will be updated in order to schedule sensor resources.

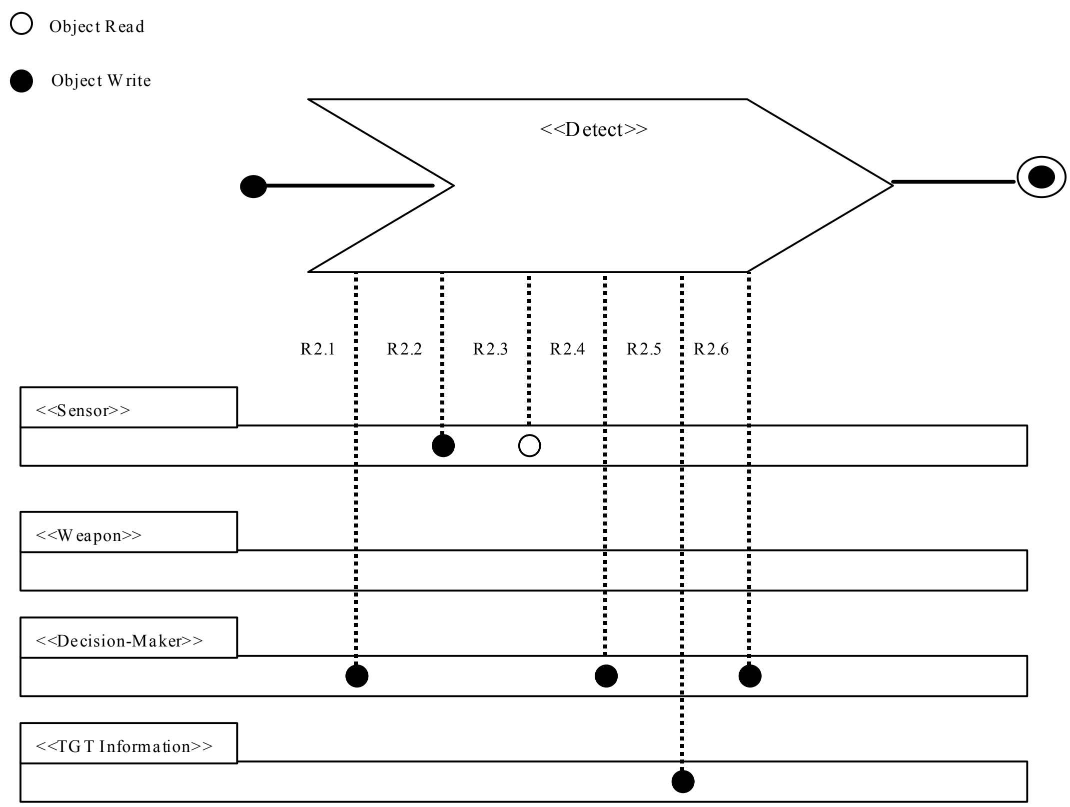



Figure (D-2) - "Decide" Assembly Line Diagram

3. Engage

***<u>Reference Package 3 (Figure D-3)</u>***

<u>1. Reference: Consult Attack Guidance Matrix (R3.1)</u>

Type: Read

Package Referenced: Target-Information

Description: Decision-maker references the attack guidance matrix for appropriate information.

<u>2. Reference: Execute (R3.2)</u>

Type: Write

Package Referenced: Weapon

Description:  Target is engaged with weapon in accordance with attack guidance.

3.  Reference: Target (R3.3)

Type:  Read

Package Referenced: Target-Information

Referenced by: Weapon

Description: Weapon retrieves target-information for target to be engaged

4.  Reference: Execute (R3.4)

Type: Write

Package Referenced: Target-Information

Description: Weapon is launched.

5.  Reference: Plan BDA (R3.5)

Type: Write

Package Referenced: Decision-Maker

Description: Identify BDA resources

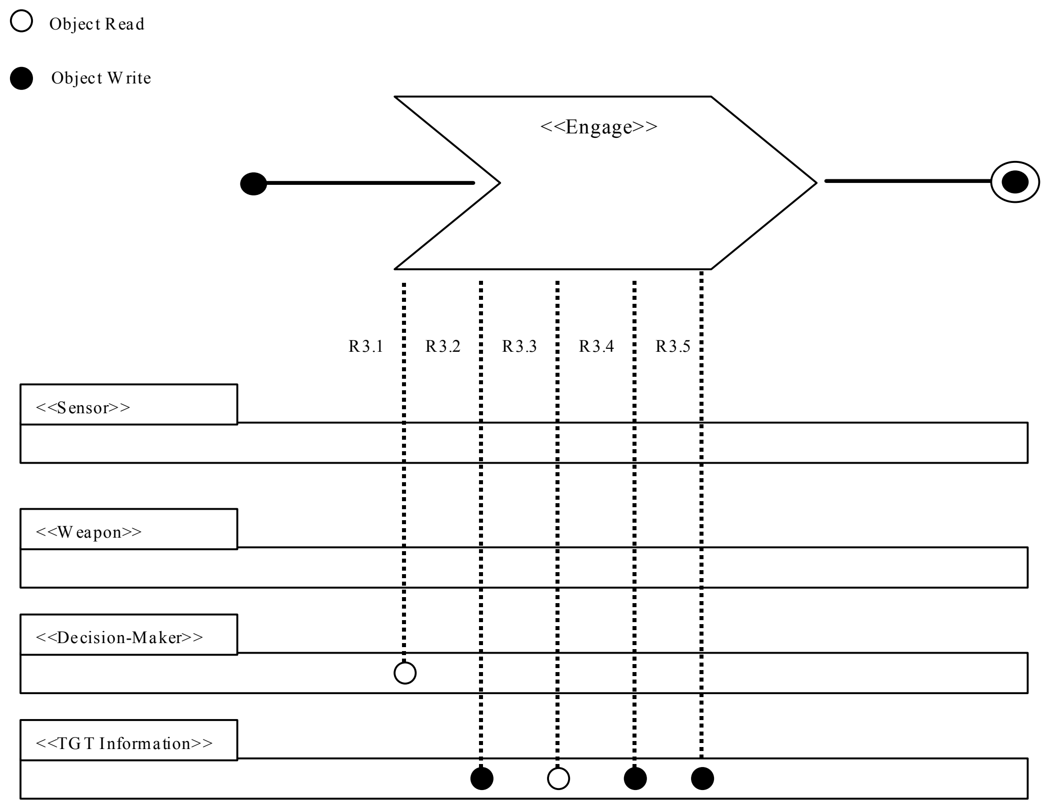



Figure (D-3) - "Engage" Assembly Line

4. Assess

***Reference Package 4 (Figure D-4)***

1. Reference: Conduct BDA (R4.1)

Type: Write

Package Referenced: Decision-Maker

Description: Sensor resources collect battle damage assessment

2. Reference: Task-Collect (R4.2)

Type: Write

Package Referenced: Sensor

Description: Sensors will be tasked to collect target data based upon collection priorities.

3. Reference: Fuse -Correlate (R4.3)

Type: Read

Package Referenced: Sensor

Description: Raw target data is read from the sensor package and evaluated.

4. Reference: Target Confirmation (R4.4)

Type: Write

Package Referenced: Target-Information

Description: Decision makers, using the fused and correlated target information, confirm the target information as the desired targets for use in the engagement process.

5. Reference: Target Information Share (R4.5)

Type: Write

Package Referenced: Target-Information

Discussion: The target confirmation information is placed in the target information package. Any decision-maker may reference this target information during the engagement process.

6. Reference: Update Commander's Guidance (R4.6)

Type: Write

Package Referenced: Decision-Maker

Description: Update commander's guidance to reflect changes in the operational and/or tactical situation.

7. Reference: Update Collection Priorities (R4.7)

Type: Write

Package Referenced: Decision-Maker

Description: Collection priorities are continually updated throughout the assault. As the operational and tactical situation changes, collection priorities will be updated in order to schedule sensor resources.

8. Reference: Update Target Information (R4.8)

Type: Write

Package Referenced: Target-Information

Description: Update Attack Guidance Matrix and target priority lists to reflect recent success or failure of the engagement.

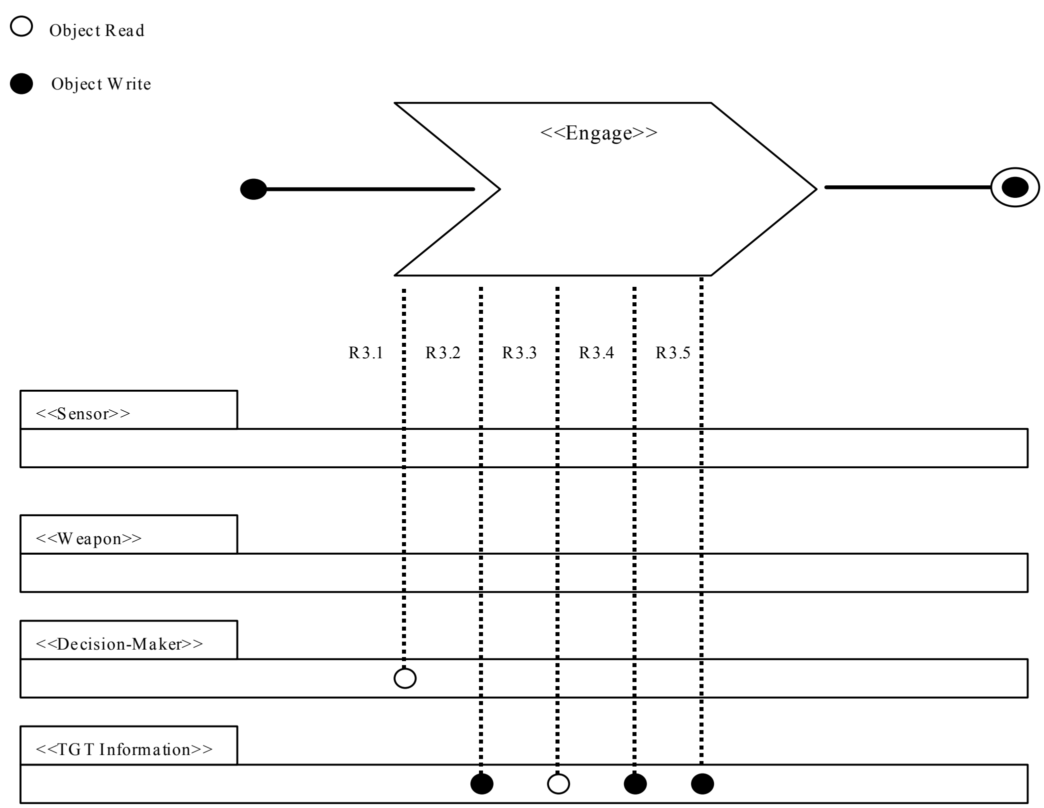



Figure (D-4) - "Assess" Assembly Line Diagram

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