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**CRISIS MANAGEMENT IN THE NATIONAL MILITARY  
COMMAND CENTER (NMCC)**

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# Report Documentation Page

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# CRISIS MANAGEMENT IN THE NATIONAL MILITARY COMMAND CENTER (NMCC)

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## Abstract

A functional architecture of NMCC crisis management is developed beginning with the identification and description of the mission and concept of operations. A functional decomposition of crisis management activities is then built based on current operating instructions and action officer interviews. The model is validated for a limited set of crisis management requirements by exercising it with data collected during an actual crisis management situation. Functional shortfalls and redundancies are examined. The result is a functional architecture of NMCC crisis management suitable as a foundation for quantitative effectiveness analysis.

## 1 Introduction

### 1.1. Problem

Each crisis managed by the NMCC has unique characteristics demanding its own special reorganization of crisis management processes. Each component task that is assigned to the Crisis Action Team will also have unique handling requirements. In such a dynamic command, control, communications and intelligence (C3I) environment, how is it possible to develop measures of effectiveness necessary to identify areas of improvement? A necessary first step is to develop a functional definition of the crisis management process, structuring and interrelating the crisis management component functions to form a complete picture of the process and its key threads.

The objective of this study is to develop and validate a model of NMCC crisis management suitable for use in assessing functionality and to use this model to identify functional shortfalls and redundancies.

### 1.2. Scope

The particular focus of the functional description is the Joint Staff crisis action coordination and decision making process carried on by the NMCC Crisis Action Team. For analysis purposes, the point of view taken is that of the Crisis Action Team, a multi-directorate, multi-agency team which is convened in the NMCC during crisis. Crisis

management activities carried out in non NMCC areas of the Joint Staff are important, but not addressed in this project. The project is descriptive in nature; no attempt is made to develop an actual requirements process model.

## 2 Approach

### 2.1 Methodology

The methodology used in this analysis begins first with a definition of mission and the concept of operations currently used to support that mission. The various operations are then structured in a functional decomposition and tied together with information flows and controls to form a functional architecture described in an IDEF<sub>0</sub> diagram. The most significant facilitating mechanisms are also annotated to identify key resources used to implement the various functions or activities. An activation of a crisis action team allows for actual crisis action observations, which are then used to check and update the model. An operations sequence diagram and the associated Petri Net are used to illustrate the approach for follow-on effectiveness analysis and to identify functional shortfalls or redundancies.

### 2.2. Functional Architecture

A functional architecture is a system model built with an understanding of mission, procedures, roles, and resources which functionally describes the various functions, their sub-functions, interrelationships, and flows. Information on mission, procedures, roles, and resources for the NMCC crisis management functional architecture is derived from reviews of existing documentation and interviews with experienced action officers. In this process, various functions are identified and arranged as a hierarchical functional decomposition which forms a skeleton for the functional architecture. Information flows between the functions in the hierarchy are then identified and documented. To complete the functional architecture, controls associated with each function are identified. The resulting functional architecture is documented as an IDEF<sub>0</sub> diagram which places each activity in specific relation to the others and identifies its inputs, outputs, and controls, along with only the key facilitating mechanisms.

2.3. Validation of Functional Architecture

Five crisis actions spanning a range of tasks were investigated in the original study in Ray (1993). One is highlighted in this paper, tracing the sequence of steps through the IDEF<sub>0</sub> functional architecture. This process enables the identification of shortcomings in both functional connectivity and resource allocation.

2.4. Operations Analysis

Functional analysis can be extended toward quantitative effectiveness evaluation using a scenario specific operations sequence diagram (OSD) and deriving executable Petri Nets. The OSD for the order development action used in validation is documented by tracing the action sequence step by step through the IDEF<sub>0</sub> system diagram. The resulting ordered trace of activated functions is documented as an operational sequence diagram and is known as a "key thread" and

identified with the particular process featured in the action sequence. The operations sequence then serves as the foundation for a Petri Net. Various key threads can be generated, each associated with a particular class of scenario, with the cumulative result ideally spanning the operational space of the system. Such an extensive analysis is not attempted here, however, with an operations sequence diagram developed only for the order generation scenario.

2.5. Modeling Techniques

IDEF<sub>0</sub> is a graphical and textual language for describing systems, their components, structure, and information and item flows. The IDEF<sub>0</sub> modeling language was developed and standardized by the US Air Force and is documented in "Design/IDEF." It is based on the Structured Analysis Design Technique (SADT), which is described in Marca and McGowan (1988).

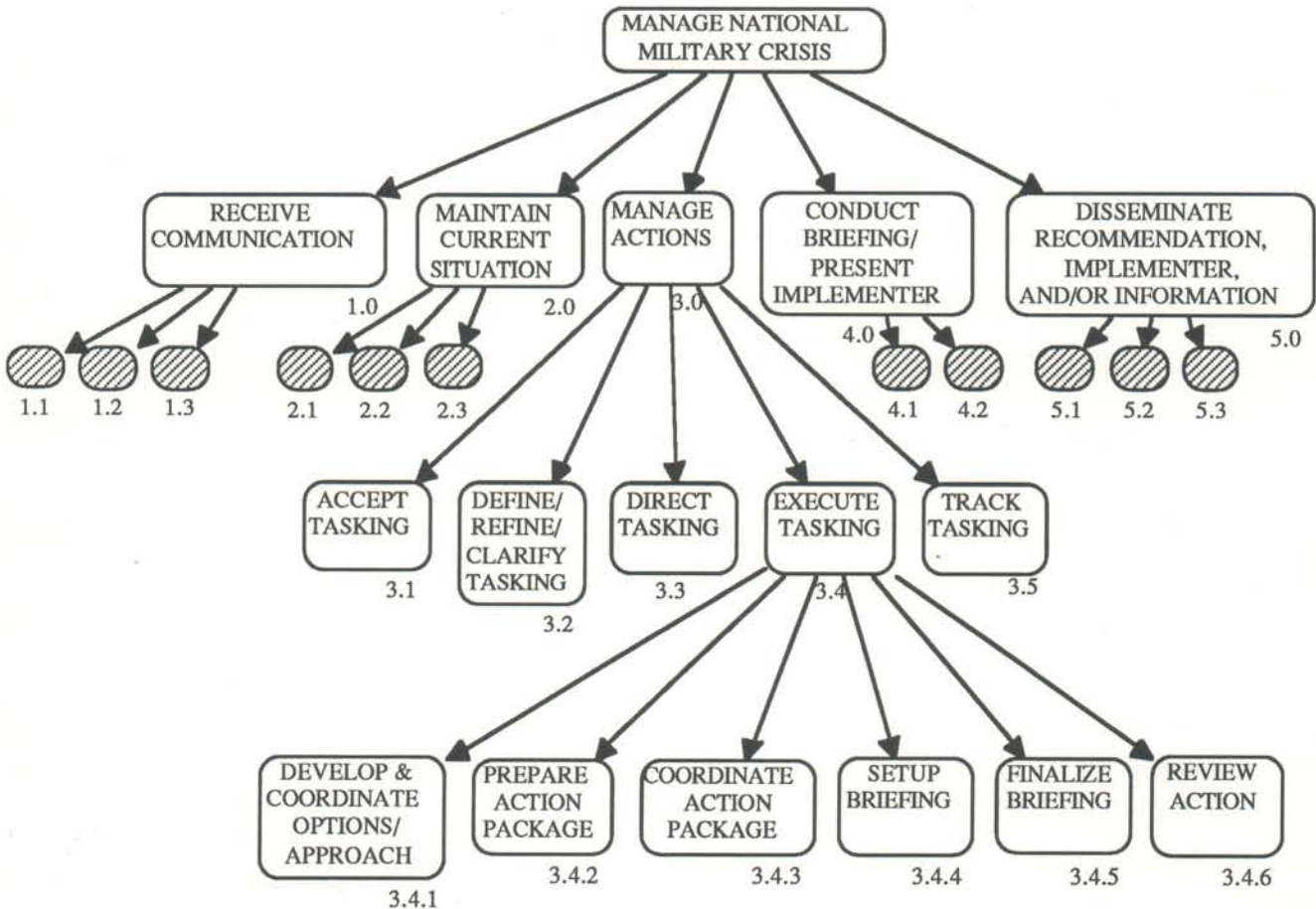


Figure 1. Functional Decomposition of Managing National Military Crisis

A functional decomposition such as Figure 1 forms the skeleton of the functional architecture. Beginning with this structure, flows, resources, and controls can be identified and documented to yield the IDEF<sub>0</sub> diagram.

The IDEF<sub>0</sub> function or activity block uses arrows on specific sides of the operation blocks for specific purposes, as illustrated in Figure 2. Arrows entering from the top indicate a controlling factor for the operation. It may be what turns it on or off, or influences the manner of activity in the operation. The flow of objects through the operation are depicted by input arrows entering from the left and output arrows exiting from the right of the block. Resources which are required by the operation are identified as mechanism arrows entering the block from the bottom.

Figure 3 is a top level view of the crisis management functional decomposition shown in Figure 1. Because it is a hierarchical decomposition, the diagrams subordinate to an IDEF<sub>0</sub> block automatically inherit the same inputs, outputs, controls, and mechanisms which must be connected into the functions of the subordinate diagram. The diagram in Figure 4 is a decomposition of the parent node in Figure 3--the child acquires all the connections of its parent.

Each of the inputs, outputs, controls, and mechanisms represented on a diagram are devolved to its subordinate diagrams and connected into the appropriate decomposed operations. The parentheses at the tail end of an arrow indicates an object which is not considered significant enough to be listed on the higher level diagram, either for reasons of clarity or of emphasis. Similarly, parentheses on the arrow head indicates an object which is involved in an operation, but which is not described at the lower level of detail.

The operational sequence diagram identifies the sequence and interrelationship of activities for a given scenario. These activities are derived directly from the functional architecture. Figure 5 depicts an operational sequence diagram derived from the "Develop and Coordinate Options" activity (3.4.1) of Figure 1.

A Petri Net representation of the operations sequence diagram (OSD) is useful in deriving analytic expressions for the system response time. Petri Nets are discussed by Murata (1989), Shah (1992), and Prabhakar (1992). Petri Nets are bipartite directed graphs. The presence of tokens enables transitions, depicted by bar nodes, and the firing of transitions generates new tokens that enable a new set of transitions. Figure 6 is a Petri Net diagram of the first five functions of the operations sequence diagram in Figure 5.

The notation "t(x)" refers to the process time of transition x. The transition labels correlate with the NMCC Crisis Management IDEF<sub>0</sub> diagrams. The response time for the net in Figure 6 is:

$$T_{RT} = t_{A3411} + \min(t_{A34121}, t_{A34122}, t_{A34123}) + t_{A3413}$$

since all three inputs are required for function A3413 to be enabled.

### 3 NMCC Crisis Management

#### 3.1. Purpose

The purpose of the NMCC is to support the Joint Staff's crisis management responsibility. Key functions of NMCC crisis management are to support decision making by the Chairman of the Joint Chiefs of Staff (CJCS), coordinate Joint actions, and coordinate with the supported CINC during crisis situations. This system consists of people, organizations, procedures, C2 systems, and facilities all structured to support CJCS crisis management. Crisis actions, involving conventional military forces in situations ranging from military presence through conflict, may be handled by teams ranging in size from the day-to-day NMCC Operations Teams, to an augmented Operations Team, a JCS Response Cell, a Crisis Action Team, or potentially an Operations Planning Group. All these teams support the Chairman and the NCA in military-related decision making, action coordination, and execution.

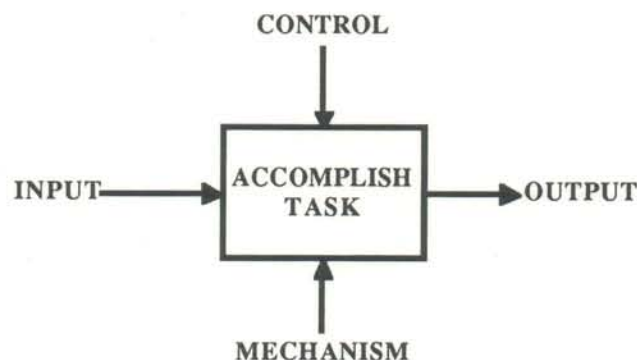


Figure 2. IDEF<sub>0</sub> Building Block

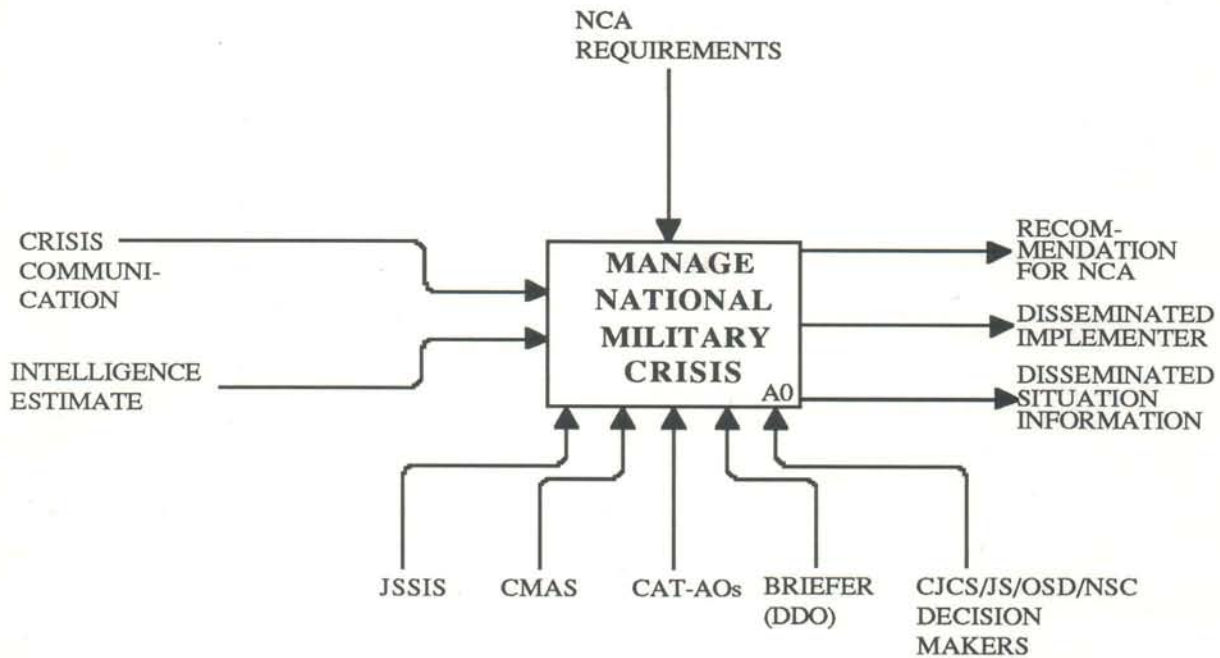


Figure 3. IDEF<sub>0</sub> Block Example: NMCC Crisis Management Context Diagram

### 3.2. Crisis Action Team

The crisis action team is intended to provide intense management of "limited" crisis situations beyond the capabilities of an operations team. The crisis action team has been the Joint Staff organization of choice for crisis management. The CAT mission is to support the J-3 in crisis management responsibilities; it is performed in three ways: coordinating joint actions, supporting CJCS decision making, and effecting liaison with the supported CINC. Specific functions of the CAT are to:

- o Prepare CAT activation/termination message and memo
- o Prepare deployment orders
- o Take actions directed by CJCS, CJS, and DO
- o Monitor situation and actions
- o Propose and evaluate alternate COA
- o Recommend critical resource distribution
- o Organize and convene emergency conferences
- o Provide situation update to JCS directorates, Services, DOD and federal agencies
- o Manage crisis actions, maintain and report action status
- o Effect liaison with NOG, LRC, JRC, CINCs, OSD, and DOS
- o Prepare after-action/lessons learned report

The CAT is typically manned with the following positions:

- o Team Chief (from J-3)
- o Deputy Team Chief
- o J-3 response cell
- o Joint Staff action officers (potentially from J-1, J-2, J-4, J-5, J-7, and J-8)

- o Service liaison officers
- o Data, Information, and Coordination Officer (DICO)
- o Public affairs officer (PAO)
- o Executive assistant (EA)
- o Other agency liaison officers as required

The NMCC CAT generates a variety of products:

- o Implementers, including warning, planning, alert, deployment, and execution orders
- o Briefings
- o Emergency action messages
- o General messages
- o Crisis information to appropriate organizations: CJCS, DJS, DDO, NOG, LRG, JRC, JS DIR, CINCs, Services, OSD Agencies, DOD Agencies, and Federal agencies
- o Coordination packages
- o Memos and e-mail
- o Telephonic messages and coordination

Crisis actions managed by the CAT are generated at several sources: Joint Staff leadership, including CJCS, DJS, DO, and DDO; CINCs; Services; OSD; White House; National Security Council; other federal agencies; and the CAP crisis response guidelist. Taskings are frequently communicated via memo, electronic message, and voice (frequently by the DDO). Emergency conferences between DOD players are also forums for requirement and tasking generation. Once a tasking is defined and assigned, its status is tracked in a action status database maintained for the team chief or deputy team chief. JOD or the J-3 response cell is responsible for providing the content for status updates. The DICO maintains the computer database. Typical actions may include the following:

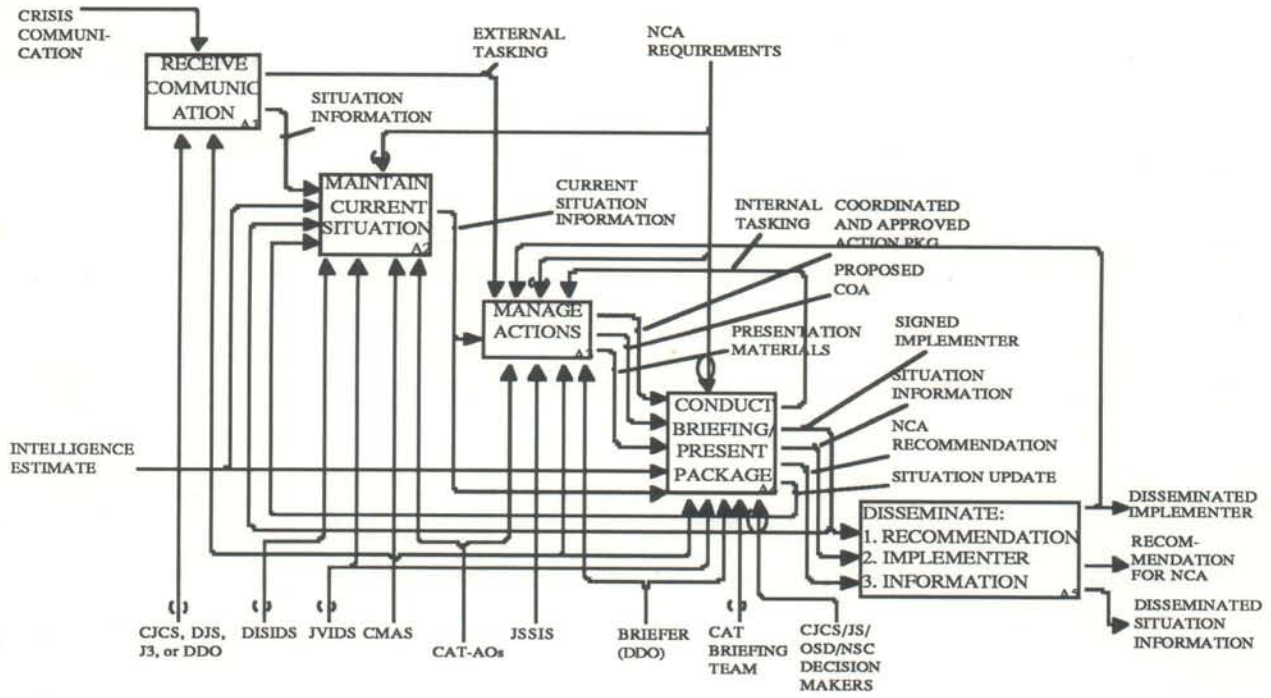


Figure 4. First Level Decomposition of Manage National Military Crisis

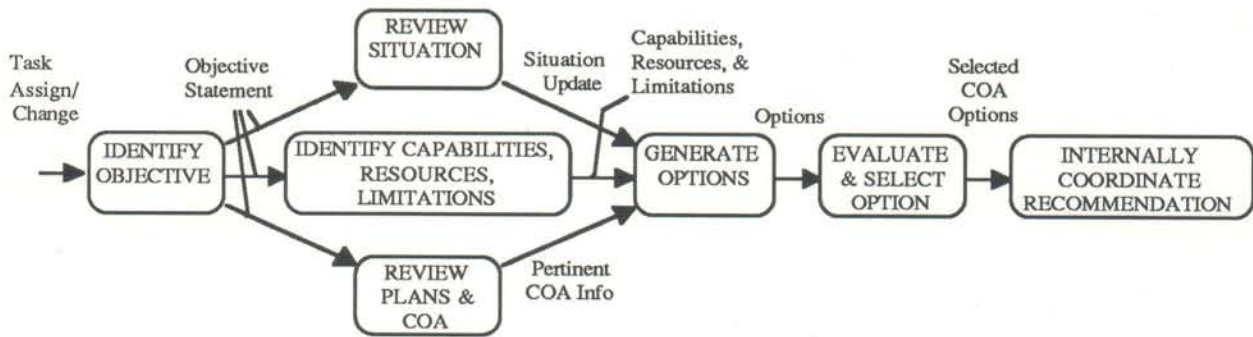


Figure 5. Operation Sequence Diagram Example

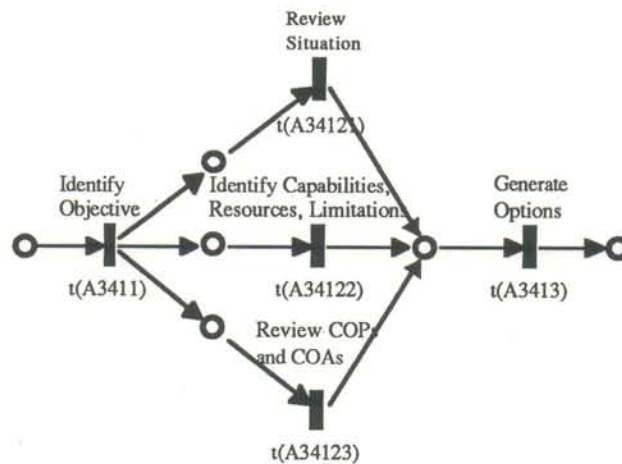


Figure 6. Petri Net Example

- o Prepare situation assessment for the White House
- o Prepare situation update briefing for SECDEF
- o Develop deployment COA
- o Develop deployment order
- o Coordinate policy issue with OSD
- o Brief the Command Group

Information required for the CAT to perform crisis management tasks may be crisis specific or of a general reference nature and may include the following:

#### *Crisis related information*

- o Situation Reports (SITREPs) from JTF, CINC, DIA, CIA, and DOS
- o Spot Reports (SPOTREPs) from field units
- o NCA guidance
- o Situation and subject area briefings
- o News wire service reports

#### *Reference information*

- o Joint Operations Plans
- o Joint Uniform Lessons Learned
- o Joint Staff Actions Guidelist
- o POC Directories

An action status database is used to log suspenses, responses owed, inputs received, and action status, the latter including entries such as "out for coordination," "modifying package," "implementer executed," and "action closed." Action close-outs are performed daily by the team chief, who reviews action summary reports and proposed close-out list prepared by the deputy team chief or executive assistant.

## 4 Analysis

### 4.1 Actual Crisis Actions

Toward the conclusion of this study an activation of the CAT provided the opportunity to capture some of the task management processes actually employed. During this crisis a variety of tasks were tracked: press releases, deployment orders, communications plans, international cooperation policy, Reserve call-up, foreign military interaction, sourcing of forces, situation briefs, and POW/MIA issues. Inaccuracies in the functional model can be identified by comparing the actual steps taken with those shown in the IDEF<sub>0</sub> diagrams. Detailed steps required for this comparison were captured for five representative cases: a congressional briefing on the operations, policy on coalition forces, public affairs guidance, laydown of forces, and deployment order development. In this paper, the last of these is presented as a single thread through the model. The model's validity is measured in how closely the action sequence matches that described in the IDEF<sub>0</sub> diagram. Model activities such as situation awareness are not activated in this key thread analysis. The complete model is found in Ray (1993).

### 4.2. Validation with Deployment Order Development Action

#### 4.2.1 Order Development Activities

Order development is one of the explicitly defined responsibilities of the CAT. The following events occurred in the highly dynamic process of developing a deployment order:

- o The supported CINC sends a message requesting forces while still in the OPORD development process; the message is first received by fax and later by DSN message
- o CAT-TC assigns tasking to J-3 Response Cell Chief with suspense
- o DTC enters action in SOA log
- o J-3 Response Cell initiates sourcing of transportation in coordination with Services
- o Supporting CINC sends message rejecting request and recommending an alternate CINC
- o J-3 Response Cell negotiates with alternate CINC to provide transportation
- o Alternate CINC performs operations analysis, briefs CINC, and phones commitment while J-3 Response Cell develops deployment order and coordinates with JS directorates and the Services, a six hour process
- o J-3 Response Cell finalizes the order upon receipt of alternate CINC commitment which is then signed off as it is passed up the chain of command
- o CJCS signs order following daily briefing
- o DTC logs action as closed

The sequence of activities in Table 1 are performed for this order development scenario, with activities referenced to the IDEF<sub>0</sub> model.

#### 4.2.2 Receive Communications

Communication with senior Joint Staff decision makers, the Services, intelligence agencies, CINC crisis action teams, action officer home organizations, and other government agencies during a crisis take various forms: electronically transmitted message, telephone conversations, briefings, memos, formal and informal meetings, letters, and fax. In addition, broadcast news is received from commercial television and news reporting services.

The "receive communications" activity includes the "extract tasking" activity employed in the order development action, as illustrated in Figure 7. The CINC message is received via the NMCC Information Distribution System (NIDS) and reviewed by the CAT team chief, who extracts tasking information which is then used in the "manage actions" activity.

#### 4.2.3 Manage Actions

The action management process is initiated with a tasking which may be generated either externally or internally with respect to the CAT. Internal tasks are those identified by the CAT team chief (CAT-TC) (or perhaps the J-3 Response Cell Chief) which become "self assigned" CAT taskings.



External tasking may come from the SECDEF, OSD, Chairman, Joint Staff directorates, CINCs, Services, and other government agencies involved in managing a crisis. The CAT-TC, assisted by a deputy (DTC) and executive assistant (EA), is the primary crisis actions manager. Tasking culled from briefings, conversations, messages, etc. are identified, assigned, executed, tracked, and evaluated by the CAT.

The decomposition of the "manage actions" activity in Figure 8 identifies a series of activities carried out in the order development action: accept tasking, define/refine/clarify tasking, direct tasking, execute tasking, and track tasking. The last three are further decomposed and include the specific activity names identified in Table 1.

Table 1. Order Development Scenario Activities

<u>Operation</u>	<u>Mechanisms</u>	<u>Reference</u>
Extract Tasking (from CINC message)	TC, Fax	A11
Accept Tasking	TC	A31
Define/Refine/Clarify Tasking	TC	A32
Determine OPR, Due Date/Time and Closure	TC	A331
Assign Tasking (to J-3 Response Cell)	TC, J-3-RC	A332
Open/Modify Action	DTC	A351
Update SOA	DTC, JSSIS	A352
Develop and Coordinate Options/Approach	J-3-RC	A341
Prepare Action Package	J-3-RC	A342
Coordinate Action Package	J-3,4,5,6; Services; LC	A343
Review Action	J-3-RC	A346
Decide Course of Action	CJCS, Briefing Team	A42
Disseminate Implementer	J-3-RC, Msg Center	A52
Close Action (via AO notification)	J-3-RC, DTC, JSSIS	A354

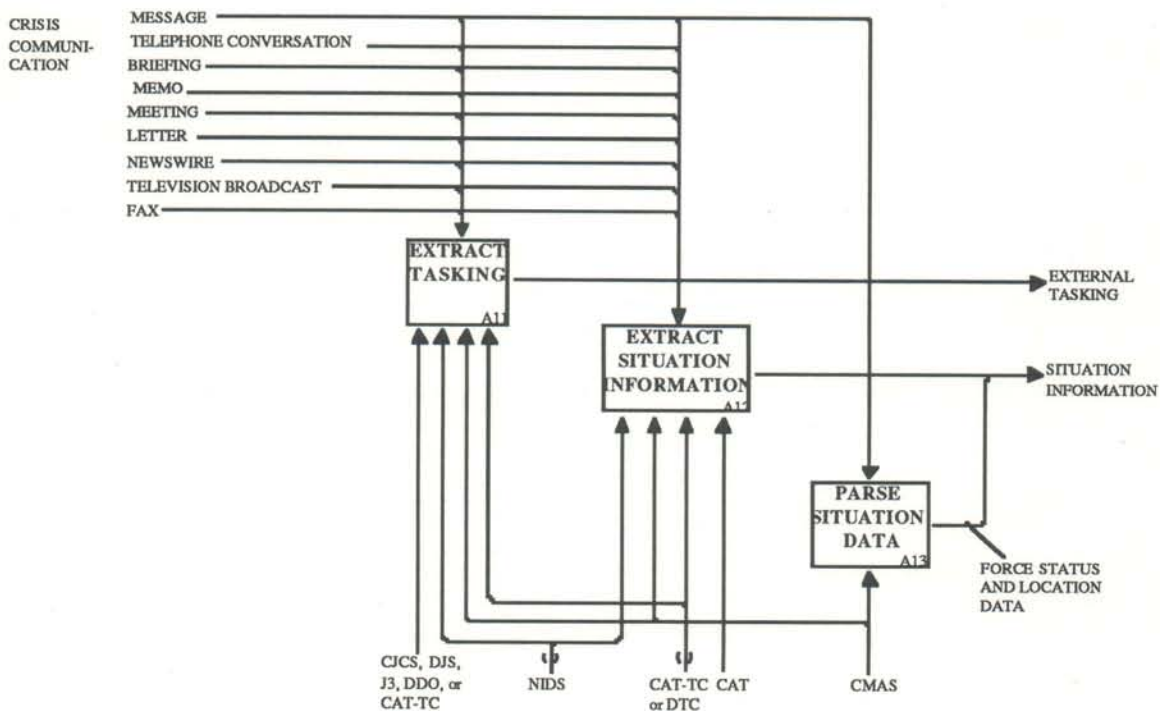


Figure 7. Receive Communications

Outputs of this crisis management process may be placed in three categories: coordinated and approved action packages, presentation materials, and a proposed courses of action. These products are passed to the "conduct briefing/present package" (A4) activity.

Tasks are accepted and defined for the CAT by the Team Chief or the Deputy Team Chief based on explicit tasking or situation information they receive. The TC and DTC are also involved in directing and overseeing the execution of the task. Other mechanisms supporting the action management functions include the CAT action officers themselves, the offices and agencies they represent and coordinate with, the briefing team associated with the CAT, and various command and control systems.

A variety of outputs and inputs are passed between the sub-functions of the "manage actions" activity. Directing and tracking the task are predicated on defining the task. Task direction begins with assignment of the task. Communication of the associated assignment parameters (due date, coordinating agencies, etc.) initiates the task execution activity (A34). These parameters also compose the initial task entry in the tracking activity (A35). The "track tasking" activity logs routine updates from the CAT-TC and CAT-AOs as generated by the "execute tasking" activity. Action status reports are reviewed continuously and during shift changes.

#### 4.2.3.1. Execute Tasking

The "execute tasking" activity generates coordinated and approved action packages, proposed course of action (COA), and presentation materials that are used by the "conduct briefing/present implementer" activity (A4). Figure 9 identifies the various activities involved in executing typical CAT taskings. Depending on the tasking and situation, some or all of these activities will be conducted.

Often a COA will be recommended by a CINC, precluding COA development by the CAT, though this is not the case for the deployment order development action. Preparing and coordinating packages are common activities, as is composing an action package consisting of a cover sheet, implementer, and background information. Preparing the associated briefings charts is usually done as a parallel operation, with the draft briefing slides built with information from an action package still in coordination. Annotated map charts may also be prepared as a briefing graphic, often relying on resources external to the NMCC. Briefing slides, coordinated action packages (including implementer), and/or other stipulated products are reviewed by the CAT-TC, DTC and the briefer before forwarding the briefing or package up the chain of command to the CJCS. The briefer, when required, is frequently on the CAT briefing team or may be the DDO. The CAT-TC or DTC may update the action status log at the conclusion of this review.

Following the deployment order development case, the J-3 Response Cell receives the action via the CAT team chief and proceeds to develop a COA (A341) and informally

coordinate (A343). The supported CINC's nonconcurrency requires a feedback to control the re-execution activity A341-a model shortcoming. With the COA finally settled, an action package produced in A343 is reviewed in A346. The resulting coordinated package is submitted for decision (see Figure 4, activity A4).

#### 4.2.3.2. Track Tasking

The deployment order generation task is tracked throughout its history in a computer-based action tracking log. Figure 10 describes the task tracking flow. Specific log actions consist of initial entry, modification/status update, status report, and closing criteria. This activity is performed on task initiation and throughout the period of performance, with entries made by the CAT team chief, deputy, or executive assistant. Updates are entered at milestones in task accomplishment, e.g., "message drafted," and "coordination complete." Closing status entry cites the date time group of the implementing message for the deployment order. Action status reports may be generated at any time but are often provided during shift changes.

#### 4.2.4. Disseminate Implementer

The Joint Staff Message Center disseminates electronic messages and is the resource used to transmit the deployment order message. Recommendations to the NCA are communicated by the CJCS in briefing or conversation. Situation information may be disseminated by CAT members to their respective organizations, CINC CATs, Services, intelligence organizations, OSD Crisis Coordination Center (CCC), Congressional committees, and other organizations that may be involved in managing the crisis. Senior Joint Staff decision makers also disseminate situation information, often via conversations and meetings.

### 4.3 Key Thread Analysis

The preceding sequence of activities for the deployment order generation action are extracted from their respective IDEF<sub>0</sub> diagrams and strung together in the operations sequence diagram in Figure 11.

Minimizing the response time for the deployment order generation process requires parallel and serial operations of the operations sequence diagram to be treated separately. Any string of serial operations in Figure 11 can benefit from a decrease in the required time to complete for any of the operations. For a parallel operation structure such as in Figure 5 (a subset of Figure 11), across the board reductions may cost more than they are worth. For the case of the J-3 Response Cell generating a deployment order, if analysis (or just experience) shows that identifying capabilities, resources, and limitations is frequently more time consuming than reviewing the situation and current operation plans, then facilitating the former should be the focus of process improvement. The coordinated briefing and package preparation processes also provides a good instance of simultaneous operations. Even though a coordination

package is still out, action officers draft slides for the CJCS presentation. The briefing is finalized when the action

package is fully coordinated.

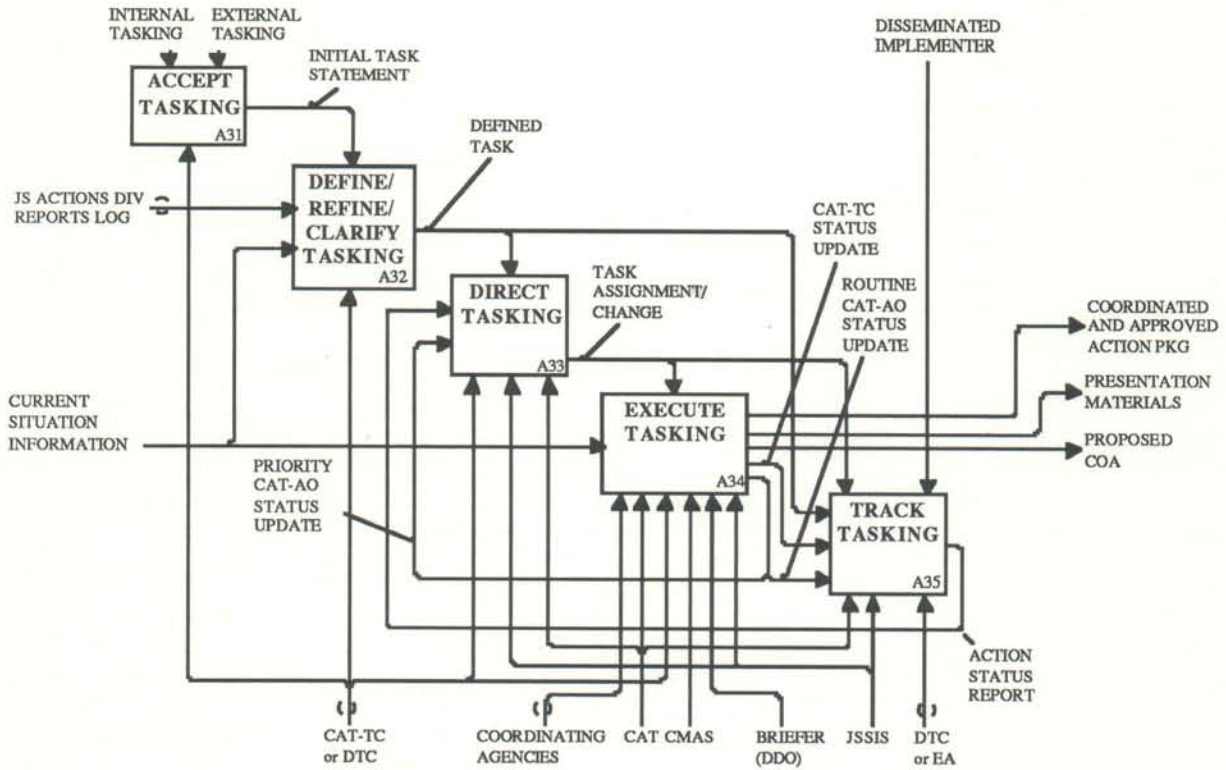


Figure 8. Manage Actions

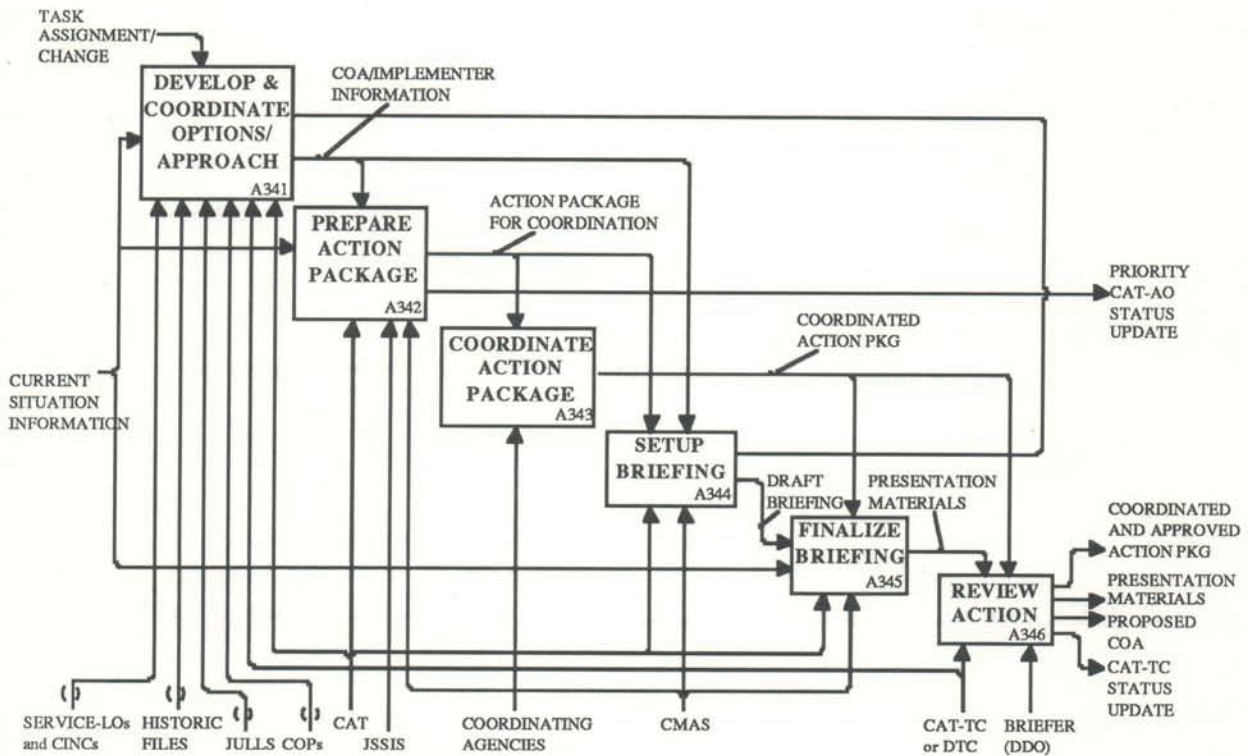


Figure 9. Execute Tasking

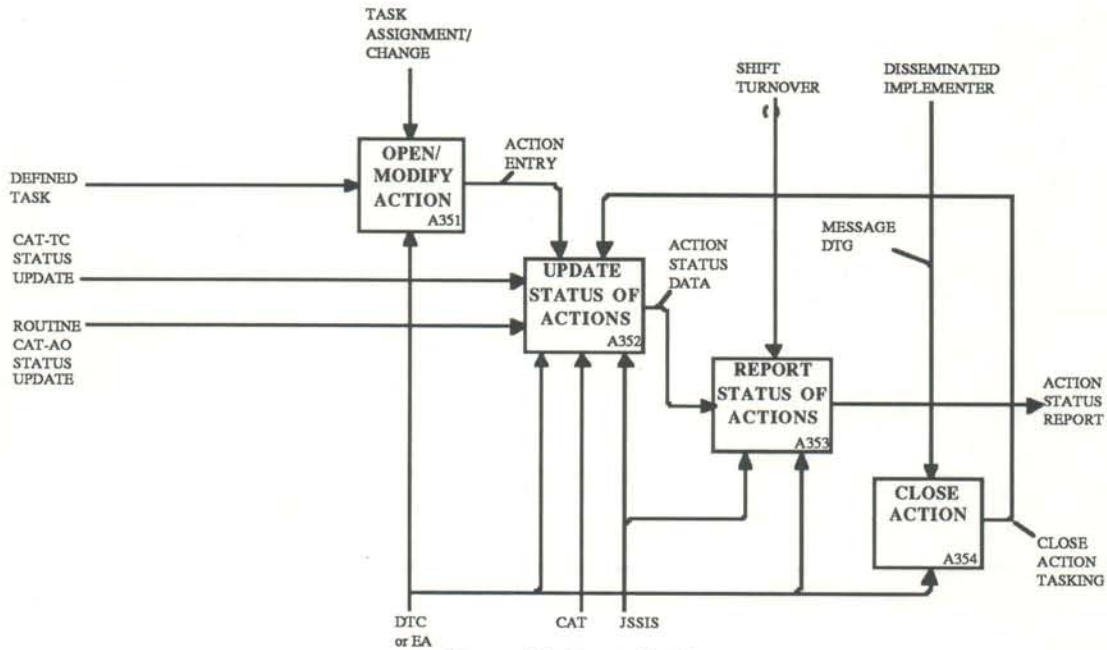


Figure 10. Track Tasking

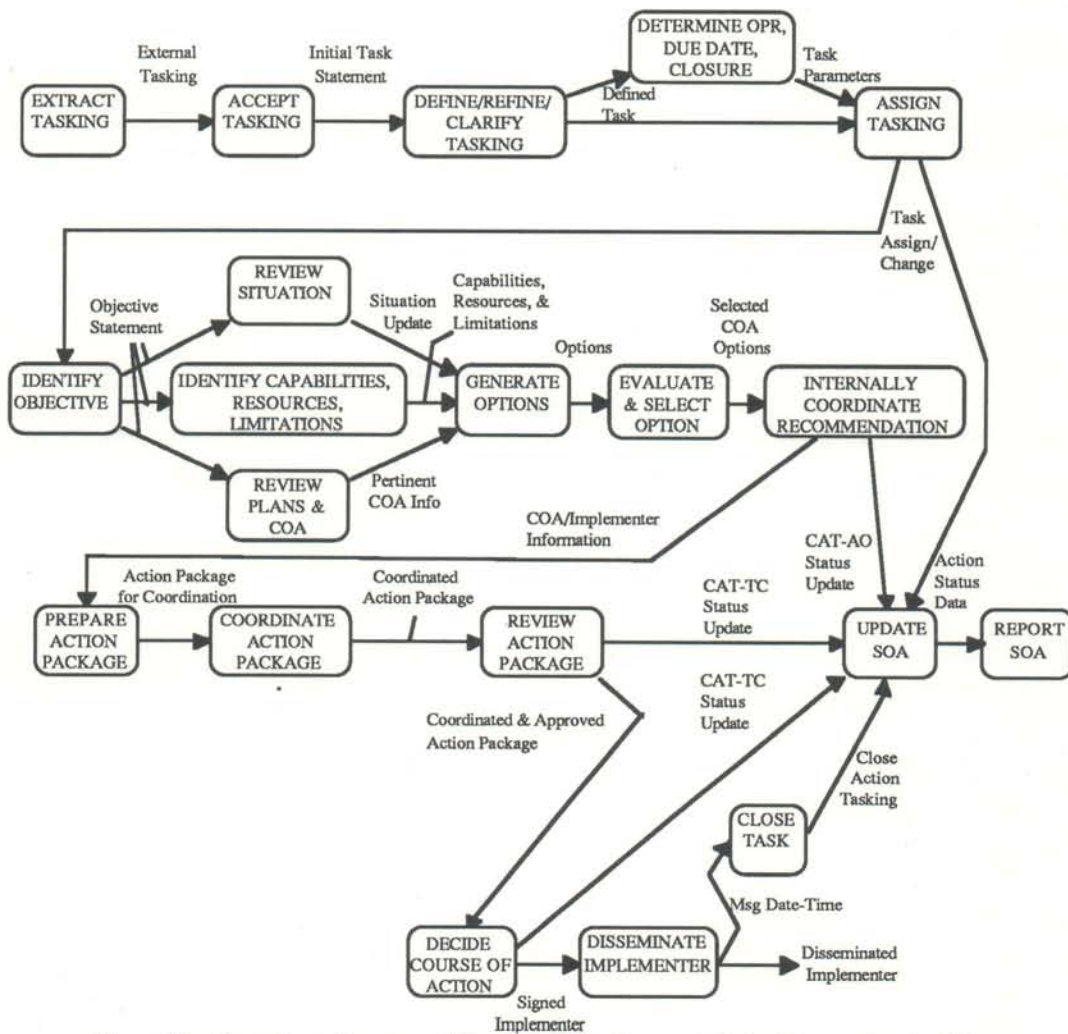


Figure 11. Operations Sequence Diagram of Deployment Order Generation Activity

Figure 12 is a Petri Net derived from the operations sequence diagram in Figure 11. The response time for

deployment order development action is derived from this net and is:

$T_{PO} =$

$$t_{A11} + t_{A31} + t_{A32} + t_{A331} + t_{A332} + t_{A3411} + \min(t_{A34121}, t_{A34122}, t_{A34123}) + t_{A3413} + t_{A3414} + t_{A3415} + t_{A42} + t_{A52}$$

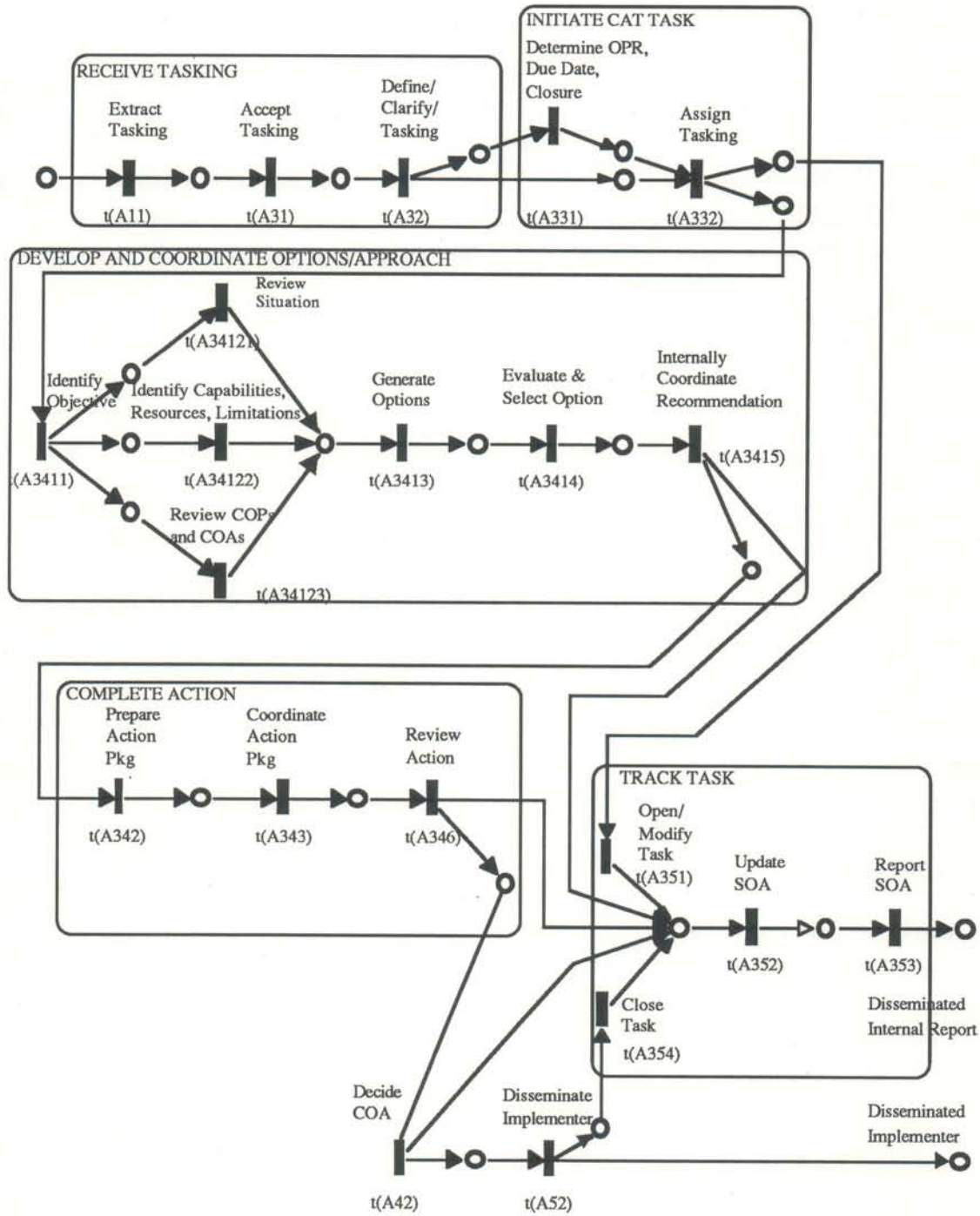


Figure 12. Petri Net Model of Deployment Order Generation Action

#### 4.4. Validation Summary

In general, action sequences followed during actual crisis operations were found to track quite closely with the functional architecture developed from action officer interviews and review of crisis action procedures prior to the crisis. Areas of model improvement tend to be related to further refinement to accommodate flexible situations rather than errors in expression. For the deployment order generation action, improvements include allowing for informal coordination and a feedback to control re-execution of the COA development activity.

### 5 Conclusions

The particular objective of the analysis underlying this paper was to develop and validate a functional architecture of NMCC crisis management in order to facilitate assessment of functional shortfalls or redundancies.

#### 5.1. Functional Architecture

A functional architecture was developed based on published Joint Staff crisis procedures and interviews with action officers experienced in actual crisis management. Only the portions of this crisis management model that were activated in an order generation scenario are shown in this paper, whereas the full model is presented and analyzed in Ray (1993).

The IDEF<sub>0</sub> functional architecture proved adequate in validation exercises; the validation process resulted in identifying additional information flows which more explicitly depict specific interactions within and external to the CAT. Testing with a range of crisis activity data demonstrated the degree of flexibility to support follow-on analysis. Vagaries inherent in IDEF<sub>0</sub> modeling will need to be resolved, however, in analyzing efficiency, resource allocation, and effectiveness. No actual functional shortfalls were identified in this functional review.

The end result is a model of NMCC crisis management, validated for certain crisis situations, which identifies CAT activities relevant to accomplishment of the crisis actions; a finding of no shortfalls in CAT functionality, and an IDEF<sub>0</sub> model that is ready for use in addressing CAT crisis management effectiveness.

#### 5.2. Future Work

This effort is the first step in a series required to evaluate NMCC crisis management. In a follow-on effort,

coherence, consistency and accuracy evaluations can begin with categorizing each crisis action, assuring adequate representation across the range of possible crisis management actions. Key thread analysis of each class can be used to identify functional shortfalls and redundancies. Response time equations like those derived in section 4.3 can be derived for the various other key thread processes. Minimizing the response time for the deployment order process requires parallel and serial operations in the operations sequence diagram to be treated separately. Follow-on tasks include: evaluating alternative crisis management organization structures, addressing logistics management activities, developing an operational architecture, crisis management requirements architecture, and physical architecture.

### References

- "Crisis Staffing Procedures," Draft J-3 Instruction 3180.11E, Joint Staff Operations Directorate, Washington, DC, 1992
- Marca, David and Clement McGowan, *Structured Analysis and Design Technique*, McGraw-Hill, New York, NY, 1988
- Murata, T., "Petri Nets: Properties, Analysis and Applications," *Proceedings of IEEE*, Vol 77, No. 4, April 1989
- Prabhakar, D. H., "Performance Evaluation of Distributed Intelligence Systems," GMU/C3I-118-TH, Center of Excellence in C3I, George Mason University, Fairfax, VA, 1992
- "Required Operational Capability for the Enhanced Crisis Management System," CSC ROC 90-1, Joint Staff, Washington, DC, Jan 1990
- Ray, Brian S., "Functional Architecture of National Military Command Center Crisis Management," GMU/C3I-130-R, Center of Excellence in C3I, George Mason University, Fairfax, VA, 1993
- Shah, Ali R., "Accuracy and Timeliness of an Evolving Tactical Picture," GMU/C3I-118-TH, Center of Excellence in C3I, George Mason University, Fairfax, VA, May 1992.