A SYSTEMS ENGINEERING TOOL FOR FMS PLANNING

By

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The Department of Defense plays a major role in executing national policy when it makes a commitment to sell a weapon system to a country. But such sales are becoming increasingly complex due to interaction and inter-relationships between the U.S. Government agencies, U.S. contractors, foreign government agencies, and foreign contractors. This high degree of complexity is particularly true in those programs involving coproduction, such as the F-16 fighter aircraft.

The F-16 program was established as a consortium effort between the U.S. and four European partners (referred to as the European Participating Governments or EPGs -- Belgium, Denmark, The Netherlands, and Norway). The agreement provided for European Coproduction of 58 percent of the procurement value of their own aircraft for the original 348 EPG F-16 buy, and 15 percent of all third country sales. In addition, several third countries themselves have requested coproduction. Also, some third countries have requested delivery of F-16s well short of normal lead times.

Thus, in such a dynamic, multi-dimensional, and multi-relational program the FMS (Foreign Military Sales) manager's job can become extremely complex. Anticipating and forestalling problems, establishing and maintaining key interfaces, responding to program changes, planning for future programs, etc., usually require information and understanding about the program by many levels of managers. Since this rarely occurs, program management rarely functions smoothly in responding to new inputs. Also, personnel turn-over, an unavoidable fact of life, typically wipes out corporate memory, resulting in the loss of important information.

This paper describes a systems engineering tool, called Function Modeling, which can very effectively assist overcoming the problem areas which programs like the F-16 typically encounter. It should be emphasized that this tool is not a replacement for good management. It does provide managers with an approach to help them solve very difficult problems of understanding the relationships between the many different activities and information users which occur in a program.

The Function Model is essentially a graphical technique for representing the activities (or functions) of the system (The FMS program) which the manager deems important. The basic rules and definitions of the technique are summarized in the Appendix. (It is recommended that the Appendix be read before proceeding). Note that this model deals with inter-relationships between activities and does not take into account the time required to accomplish the activity. Thus, it compliments other well known systems engineering tools, such as Gant charts and Critical Path Networks.

The remainder of this paper will describe an application of the Function Model to the FMS sale to Pakistan (Peace Gate). This program required delivery and operation of the first six F-16s in Pakistan within 12 months of the signing of the LOA. Normal lead time is 42 months. The fact that this was accomplished on schedule without adverse impact to the USAF F-16 program speaks well for the management of the program. The model which follows is an attempt to convey to managers who did not participate in the Peace Gate program some examples of what was learned in the crucible of a high interest, accelerated program.

The Peace Gate program involved initial delivery of six F-16s and base activation in Pakistan within 12 months of LOA signature and delivery of 34 aircraft within normal lead time. Figure 1 is a high level graphical model of the Peace Gate program. Figure 2 is a subdivision of the activity shown in Figure 1. Table I contains the high level node tree for the program. Note that Figure 1 is a graphical representation of activity A_0, and Figure 2 shows the inter-relationship between activities A_1, A_2, A_3, and A_4.

The Program Management Plan (PMP) is an extremely important document. It specifically states who is responsible for what. The process used to create the PMP is also important, since, during the process of proposing the plan, the participants gain an understanding of what and how they will accomplish their tasks and who they need to interact with. Table II is a Node Tree developing the A24 activity, "Create Program Management Plan." Figure 3 is the graphical representation of the A24231124 Activity (or Node), "Assign Propulsion SPO Tasks."

These illustrations of the Function Model, derived from one experience with the Peace Gate program, were meant to demonstrate the application of the model. In order to obtain the maximum utility from this concept, the A_1 through A_4 activities should be developed fully (i.e., to the lowest level of detail that provides meaningful data), and the model should not be the product of a single person or office, but integrate the comments from all interested parties. In this way, a complete, accurate model can be developed. Such a model could be useful in managing future FMS programs and in describing the FMS program for training purposes. It can provide a tool to organize the mountainous amount of information and activities generated for FMS programs.

APPENDIX

The first step in constructing any model is to define the system. This is done by declaring what activity will be modeled. For example, an activity "Conduct an FMS Program" can be modeled provided the boundaries and restrictions of the system are specified. Thus, the purpose, viewpoint, and context of the model must be explicitly described.

The next step is preparation of the data. This is done by listing all the activities which are required to accomplish the activity being modeled. Personal knowledge, information from experts, consultation with reference material, etc., are all sources of this information. The activities are then grouped into logical sets. They will normally fall into a hierarchical pattern, so the next step is to arrange them that way. The principal activity being modeled is labeled A_0. A basic rule is that an activity cannot be further broken down (or "decomposed" as the systems analysts say) into more than six activities. Thus, the A_0 activity (or "Node") can be broken down into A_1 through A_6. Likewise, A_1 can be broken down into A_{11} through A_{16}; A_{11} can be broken down into A_{111} through A_{116}, etc. (Of course, an activity need not be broken down into 6 activities if fewer such activities are adequate.) The activity is described by an action verb with a subject. A listing of activities in hierarchical order is called a Node Tree. It is this Node Tree which serves as the building block for the model.

Each activity generally has information input into it and output from it. The activity changes the input information into the output information. By convention, the inputs are shown entering the activity box from the left and the output exiting the box to the right. Every activity must have at least one control. This control provides the required rules, performance criteria, and evaluation data by which the activity accomplishes its mission. In other words, the control serves as the executive. By convention, if an item is both an input and a control, it is only shown as a control. Thus, every activity must have a control and an output, but need not have an input. The controls are shown entering the activity box from the top.

Activities can accomplish their mission through the application of physical processes and equipment, called mechanisms. If it is useful to indicate the mechanisms on the model, they are shown entering the activity box from the bottom.

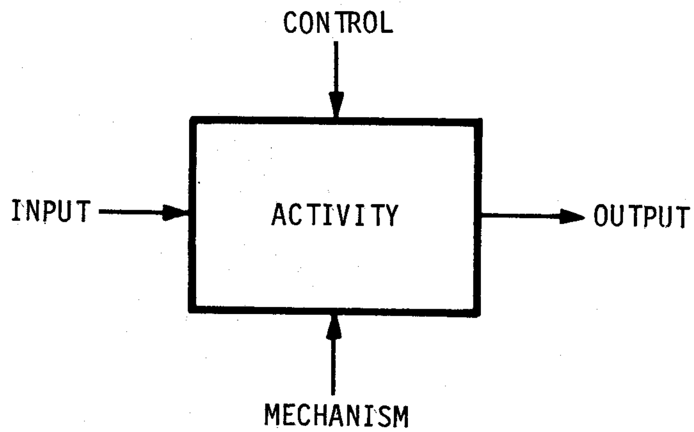
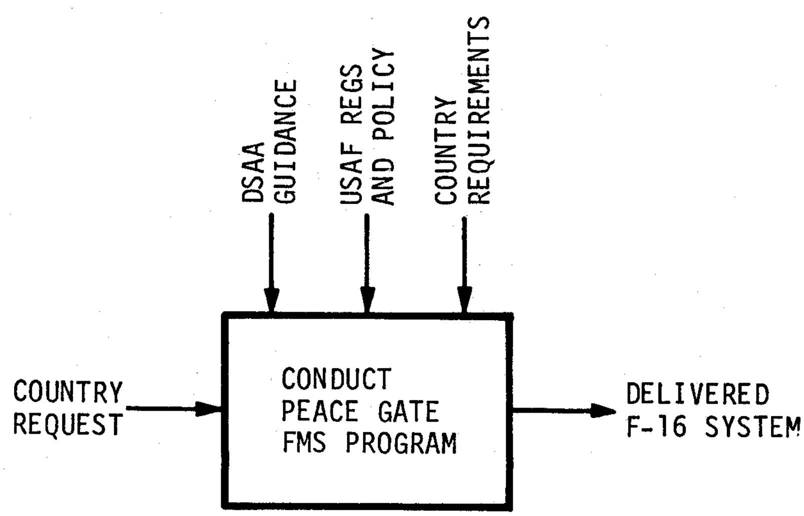
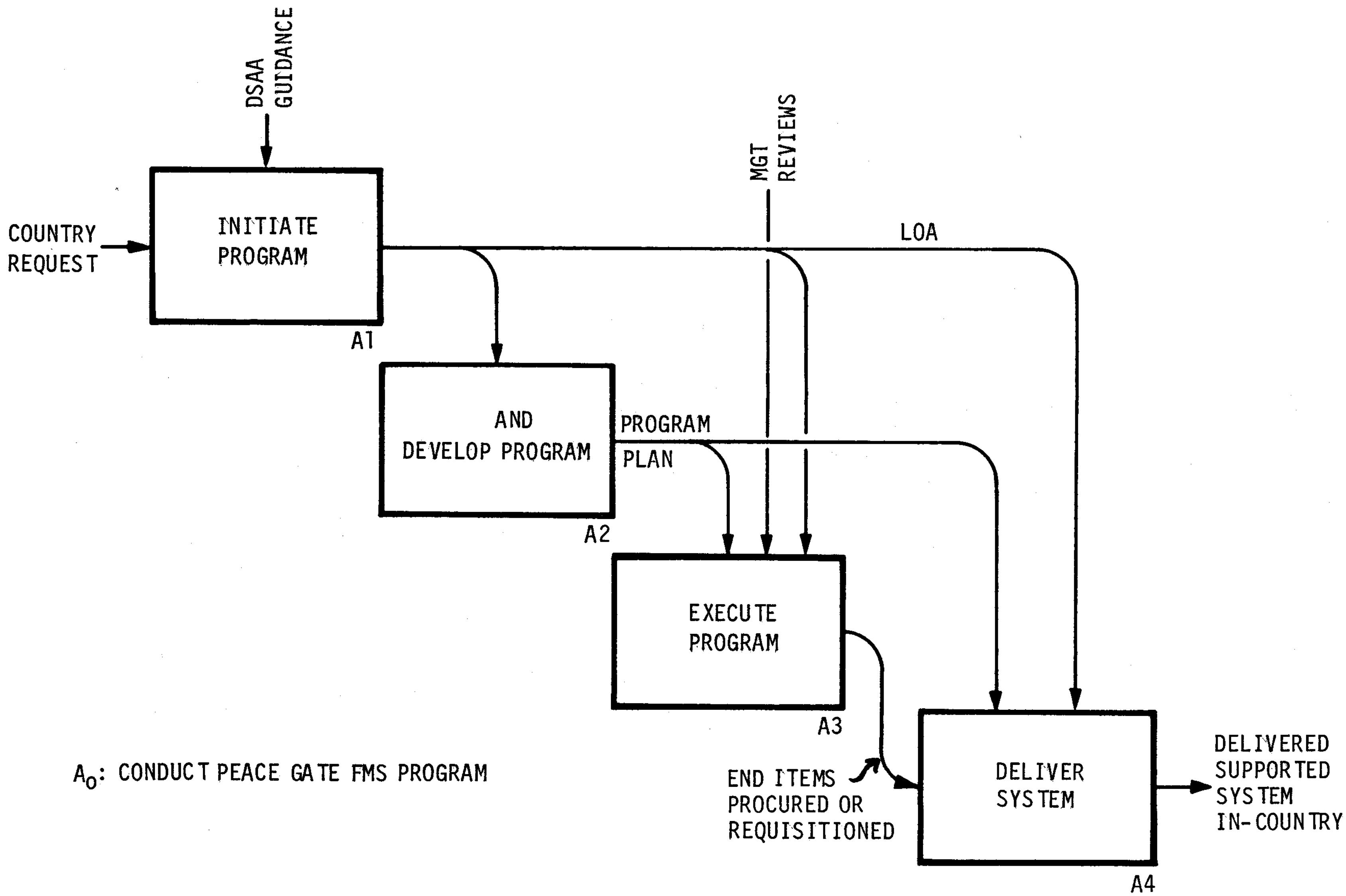


FIGURE 1



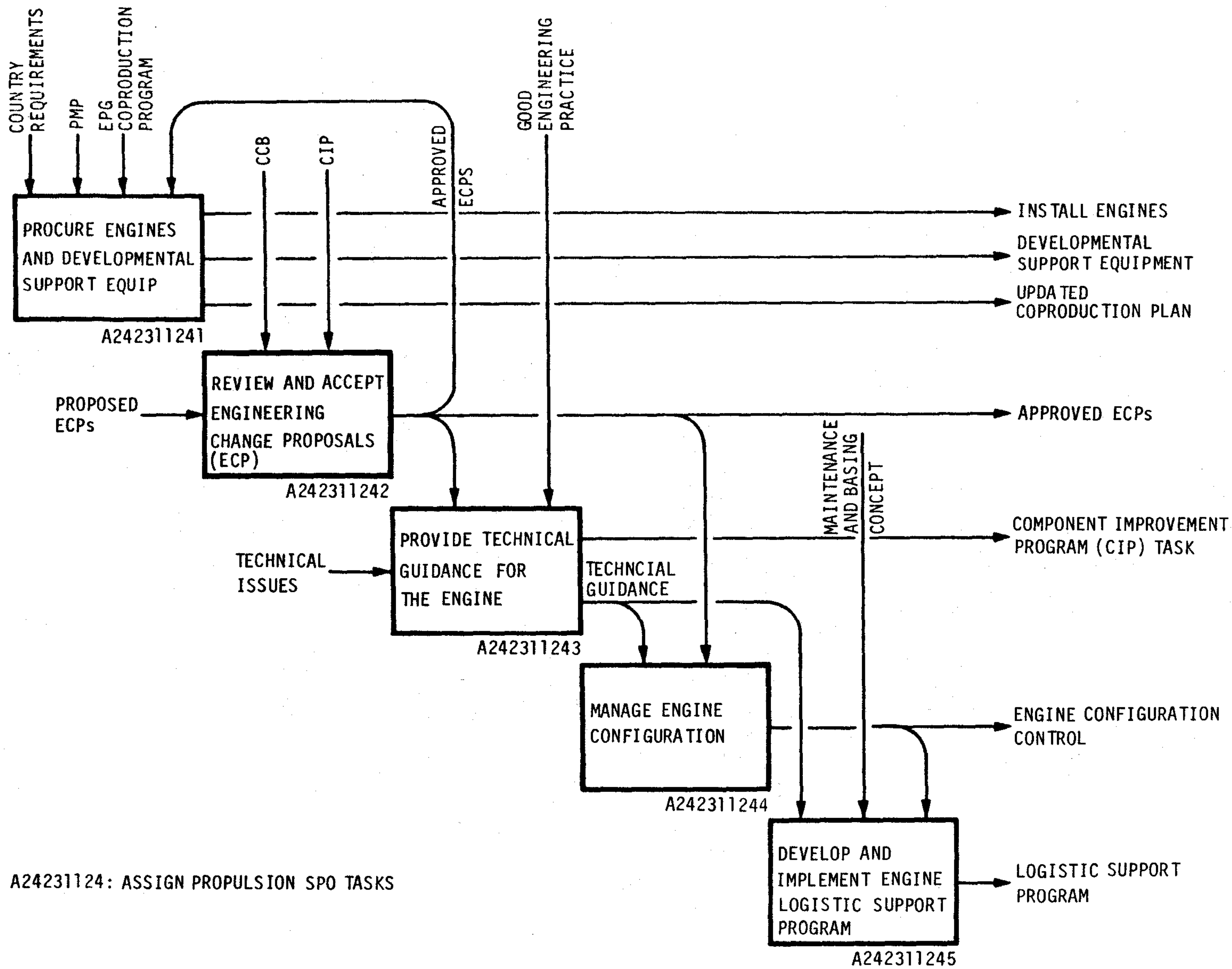
PURPOSE: DELINEATE THE FMS PROCESS
VIEWPOINT: AIR STAFF PROGRAM MANAGER
CONTEXT: USAF FMS PROGRAM

FIGURE 2



A_0: CONDUCT PEACE GATE FMS PROGRAM

FIGURE 3



A24231124: ASSIGN PROPULSION SPO TASKS

TABLE I

NODE TREE - OVERALL

AO: Conduct Peace Gate FMS Program

A1: Initiate Program

- A11: Prepare P&R
- A12: Process Letter of Request
- A13: Prepare Pricing and Availability
- A14: Perform Letter of Offer Processing and Presentation
- A15: Issue Obligation Authority and Implementing Authority

A2: Define and Develop Plan

- A21: Conduct Post Acceptance Review
- A22: Establish Program Milestone
- A23: Conduct Site Survey
- A24: Create Program Management Plan
- A25: Definitize Program Requirements

A3: Execute the Program

- A31: Provide Integration
- A32: Provide Procurement
- A33: Provide Procurement for Engine
- A34: Requisition and Ship Items
- A35: Review Program Performance

A4: Delivery and Activate System

- A41: Deliver System
- A42: Activate Site
- A43: Ferry Aircraft to Site
- A44: Monitor Delivery of System
- A45: Completion and Closure of Program

TABLE II

NODE TREE - CREATE PROGRAM MANAGEMENT PLAN

A24: Create Program Management Plan (PMP)

- A241: Define Requirement
- A242: Initiate Organizational Build Up for PMP
  - A2421: Delineate Required Tasks
  - A2422: Establish PMP Milestones
  - A2423: Assign Responsibilities
    - A24231: Differentiate Tasks
      - A242311: Assign Government Tasks
        - A2423111: Define Air Staff Tasks
        - A2423112: Define AFSC Tasks
          - A24231121: Definitize HQ Air Force System Command Tasks
          - A24231122: Assign F-16 SPO Tasks
          - A24231123: Assign Simulator SPO Tasks
          - A24231124: Assign Propulsion SPO Tasks
            - A242311241: Procure Engines and Developmental Support Equipment
            - A242311242: Review and Accept Engineering Change Proposals
            - A242311243: Provide Technical Guidance for the Engine
            - A242311244: Manage Engine Configuration
            - A242311245: Develop and Implement Engine Logistics Support Program
          - A24231125: Determine Other Tasks
        - A2423113: Define Tactical Air Command Tasks
        - A2423114: Define Air Training Command Tasks
        - A2423115: Define Air Force Logistic Command (AFLC) Tasks
          - A24231151: Definitize HQ AFLC Tasks
          - A24231152: Define AFLC International Logistic Center Tasks
          - A24231153: Assign Air Logistic Center (ALC) Tasks
            - A242311531: Define Ogden ALC Tasks
            - A242311532: Define San Antonio ALC Tasks
            - A242311533: Define Oklahoma City ALC Tasks
            - A242311534: Define Warner-Robbins ALC Tasks
            - A242311535: Define Aerospace Guidance and Metrology Center Tasks
      - A242312: Assign Contractor Tasks
      - A242313: Identify Country Tasks

A24232: Establish Responsibilities
A24233: Schedule Meetings for PMP Preparation
A24234: Integrate Plan

A243: Prepare and Publish the PMP

A2431: Evaluate Previous PMPs
A2432: Collect Inputs
A2433: Prepare Plan
A2434: Publish and Distribute the PMP

A244: Utilize the PMP

A245: Update the PMP

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