Software Productivity Consortium

Two Synthesis Applications: Boeing/Navy/Stars Flight Training Systems and Rockwell Command & Control Systems

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TWO SYNTHESIS APPLICATIONS:

BOEING/NAVY/STARS FLIGHT TRAINING SYSTEMS

K.C. King

AND ROCKWELL COMMAND & CONTROL SYSTEMS

Jerri Turner-Harris

SPC-94035-CMC

VERSION 01.00.00

MAY 1994

This material is based in part upon work sponsored by the Advanced Research Projects Agency under Grant # MDA972-92-J-1018. The content does not necessarily reflect the position or the policy of the U.S. Government, and no official endorsement should be inferred.

This document accompanies a videotape of the same presentation recorded live at the Software Productivity Consortium in March 1994. It is recommended that the videotape be viewed with these viewgraphs at hand.

Produced by the
SOFTWARE PRODUCTIVITY CONSORTIUM
under contract to the
VIRGINIA CENTER OF EXCELLENCE
FOR SOFTWARE REUSE AND TECHNOLOGY TRANSFER
SPC Building
2214 Rock Hill Road
Herndon, Virginia 22070

ABSTRACT

TWO SYNTHESIS APPLICATIONS: BOEING/NAVY/STARS FLIGHT TRAINING SYSTEMS AND ROCKWELL COMMAND & CONTROL SYSTEMS

K.C. King, Boeing STARS Demonstration Project Manager
Jerri Turner-Harris, Rockwell's Command and Control Systems Division

K.C. King presents the Boeing/Navy/STARS demonstration of the Consortium's Synthesis methodology for software reuse on Navy Flight Training Systems. Synthesis is the foundation for an approach being used by Boeing and a U.S. Navy/STARS team to develop software for the Navy's T-34C flight simulator trainer. A major reuse strategy of the program is the use of a "two life-cycle model", requiring that the traditional application development life cycle be "front-ended" with a separate, but coordinated, life cycle that creates process-driven software assets for a defined product line (or family) of systems. The mastering of variations in requirements between similar systems is at the heart of Synthesis. Mr. King describes how they have used Synthesis in a comprehensive, "leveraged" mode, fully deploying the Synthesis methodology throughout the program.

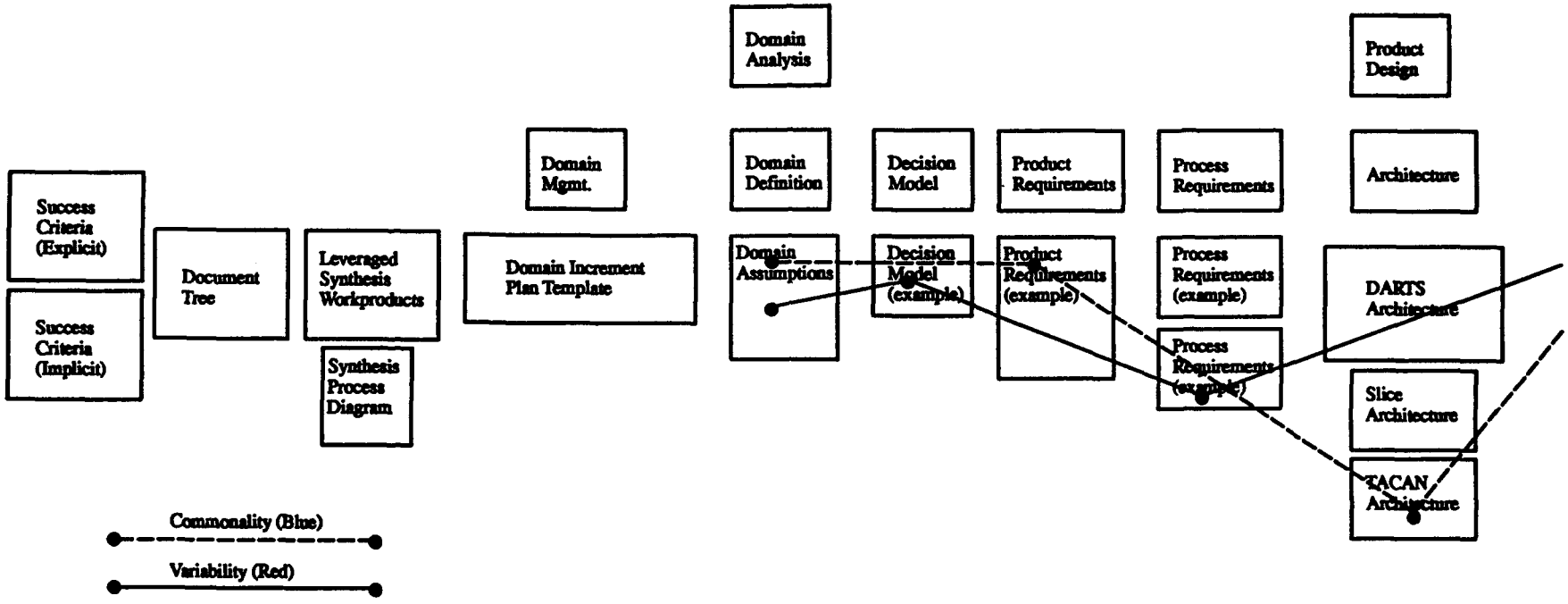
Jerri Turner-Harris of Rockwell's CCSD discusses their use of Synthesis to create a "domain engineering" approach to developing interprocessor communication and message handling systems for commercial clients. Ms. Turner-Harris explains how Rockwell is implementing Synthesis in their communications domain to eventually allow them to develop new systems in a fraction of the time currently required.

This video is intended for systems and software engineering development lead engineers, project managers, and division managers working in the area of system and software engineering. Viewers will benefit by gaining insight into the synthesis process and the experiences of others who are successfully applying synthesis.

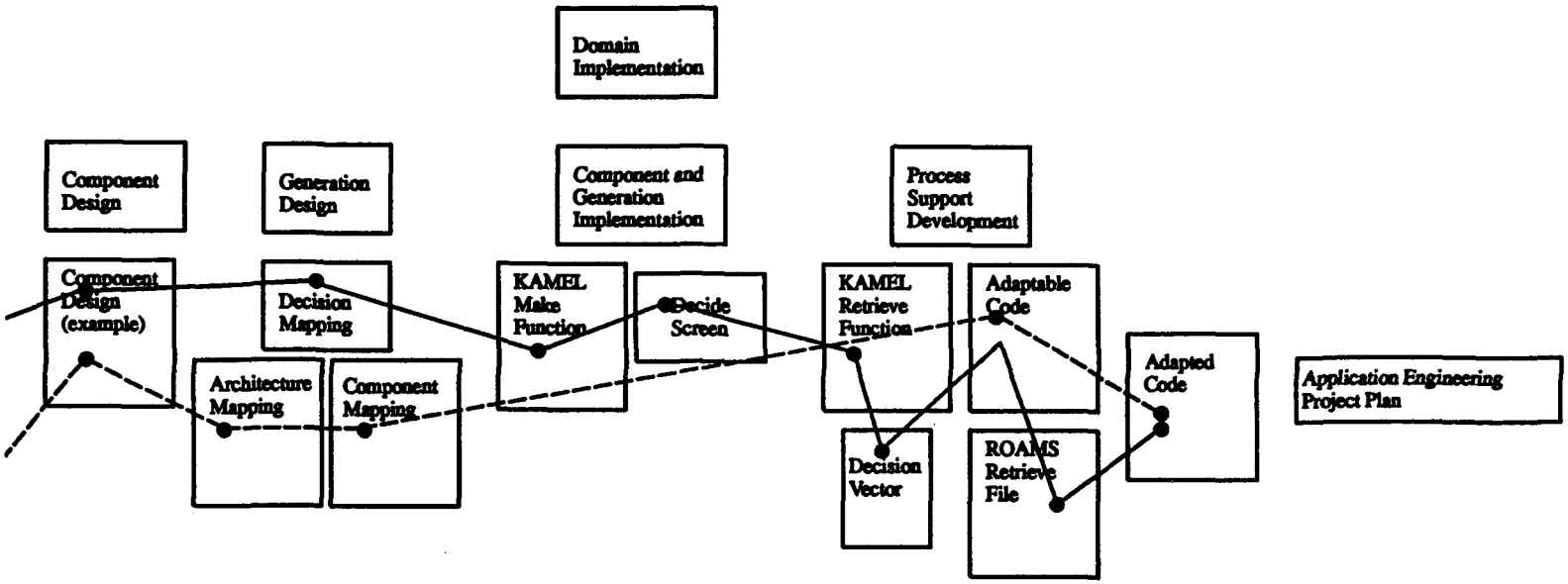
ARPA STARS PROGRAM
Boeing/Navy Demonstration Project
Navy Flight Training Systems

Presented by
K. C. King

Boeing STARS Demo Program Manager



Overview of "The Wall" (1 of 2)



Overview of "The Wall" (2 of 2)

Success Criteria (Explicit)

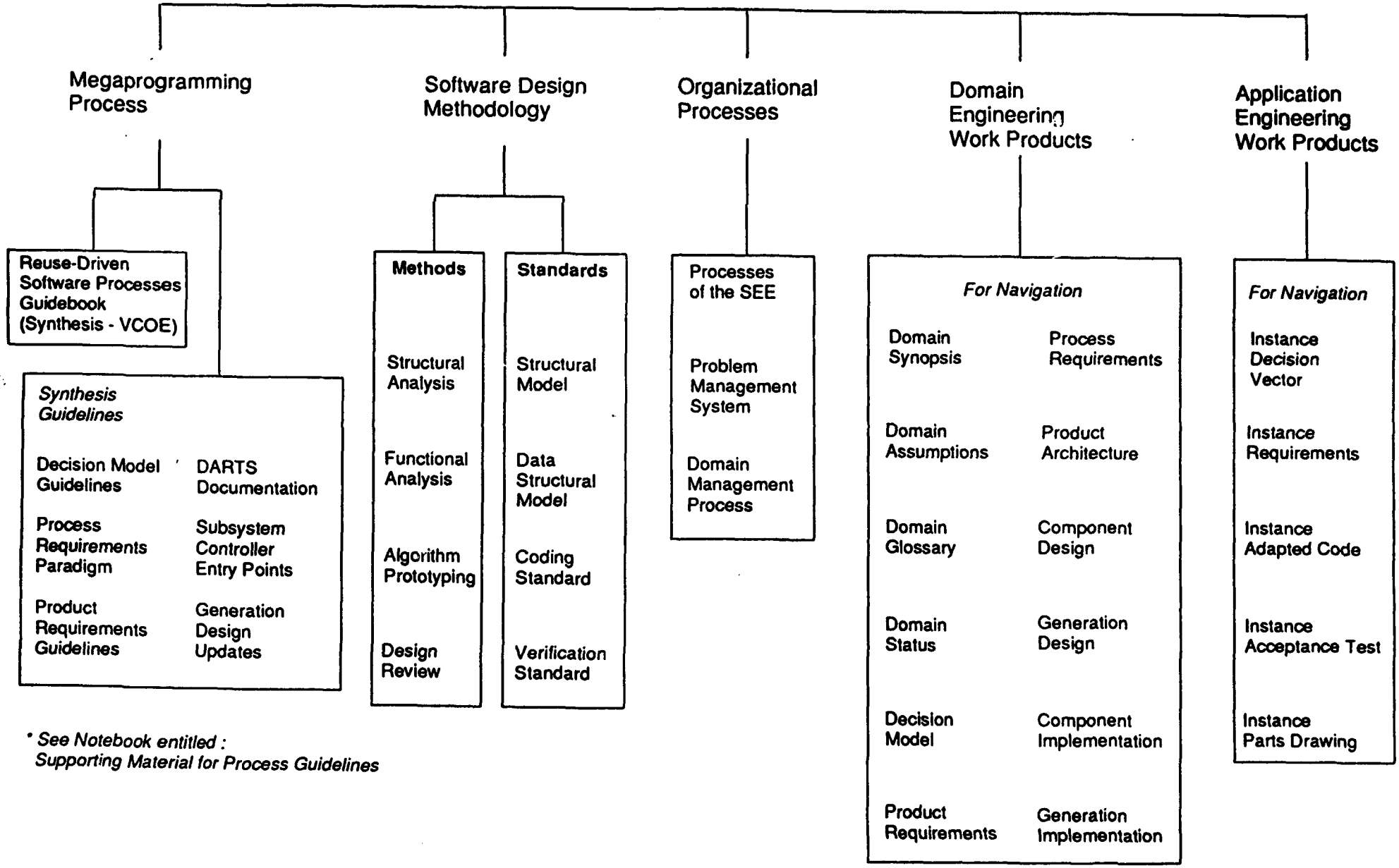
	Have lessons learned been documented?
	Have required work products been developed?
	Has the AE process been developed?
	Has the AE process been enacted in the SEE?
	Have the AE processes been followed?
	Have the functional requirements for Nav/Com been met?
	Were the requirements developed in the time allocated?
	Were metrics collected?
	Were processes documented?

Success Criteria (Implicit)

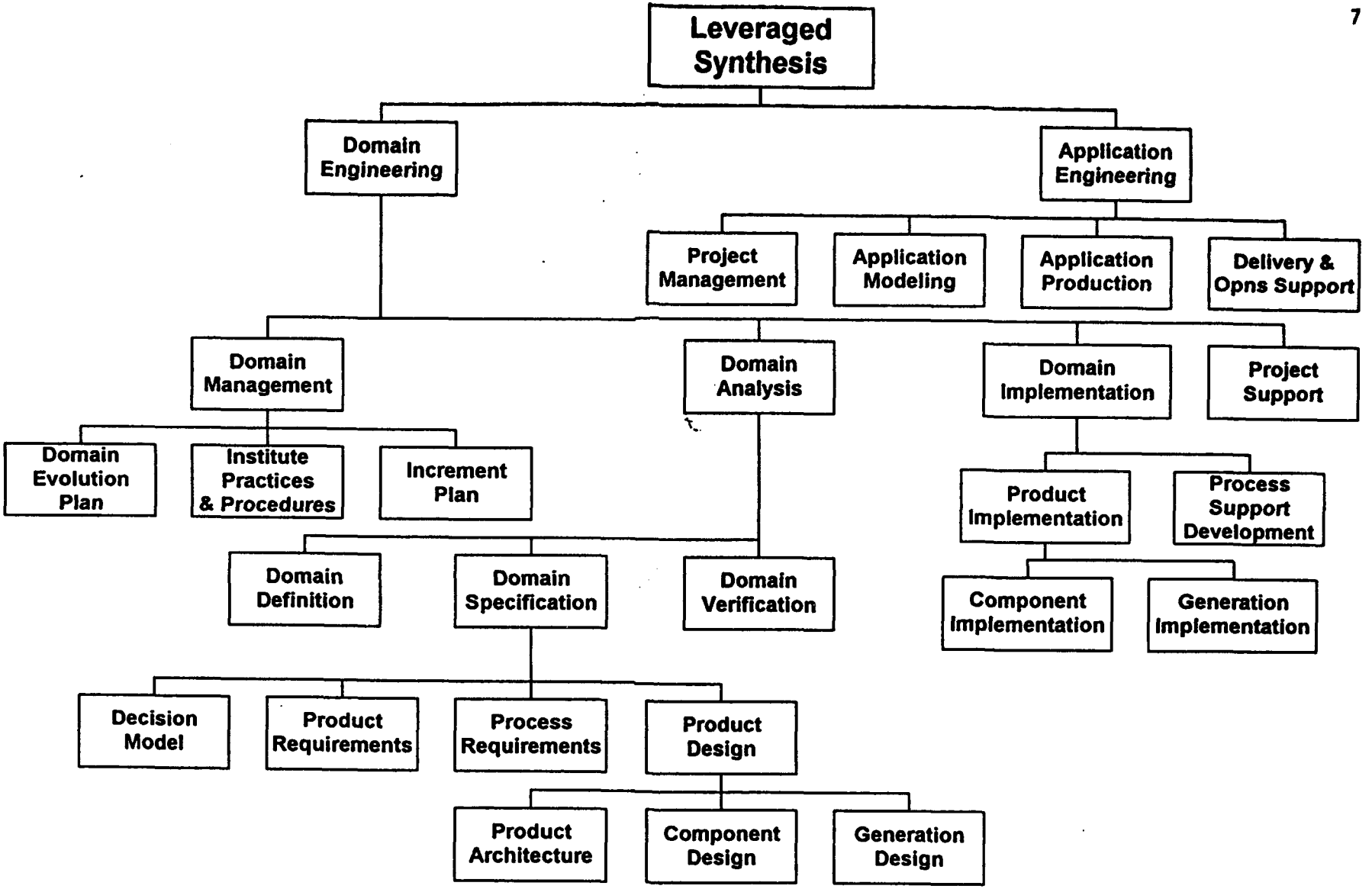
Is the team ready for the Performance Phase?

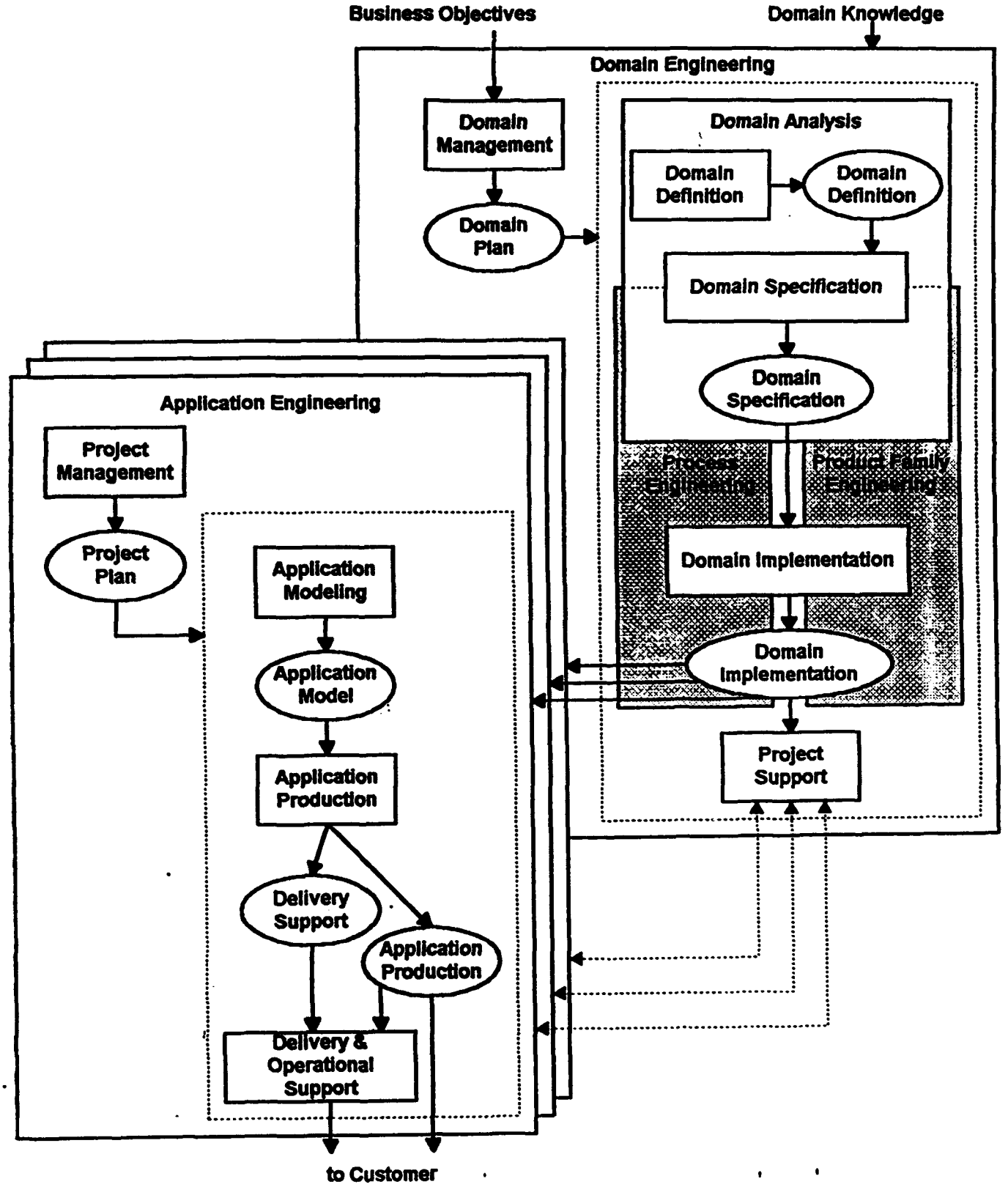
	The team has a complete set of processes
	The team has confidence in the effectiveness of those processes and the capability to perform them
	There is effective automated support for these processes
	The team understands remaining risks and has a plan to control their impact
	The team has a realistic, agreed to, and a visible plan to accomplish the demo
	The team has the critical resources and a credible plan for acquiring additional resources
	Senior leadership is committed to giving mega programming a fair test

AVTS Pilot Demonstration Project
Document Tree



* *See Notebook entitled :*
Supporting Material for Process Guidelines


Leveraged Synthesis
Domain Engineering
Application Engineering
Project Management
Application Modeling
Application Production
Delivery & Opns Support
Domain Management
Domain Analysis
Domain Implementation
Project Support
Domain Evolution Plan
Institute Practices & Procedures
Increment Plan
Product Implementation
Process Support Development
Domain Definition
Domain Specification
Domain Verification
Component Implementation
Generation Implementation
Decision Model
Product Requirements
Process Requirements
Product Design
Product Architecture
Component Design
Generation Design


Business Objectives
Domain Knowledge
Domain Engineering
Domain Management
Domain Plan
Domain Analysis
Domain Definition
Domain Definition
Domain Specification
Domain Specification
Process Engineering
Product Family Engineering
Domain Implementation
Domain Implementation
Project Support
Application Engineering
Project Management
Project Plan
Application Modeling
Application Model
Application Production
Delivery Support
Application Production
Delivery & Operational Support
to Customer

Domain Management

Purpose: Responsible for managing business area resources to achieve design business objectives

Product: Domain Plan

- Domain Evolution Plan - Long Term
- Domain Increment Plan - Near Term
- Practices and Procedures

Lessons Learned:

- Formal Domain Plan is essential

Domain Definition

- **Concepts:**
  - Description of the scope of the domain
  - Definition of the terminologies
  - Identification of commonalities and variabilities
  - Determine technical maturity of the domain
  - Determine exclusions within the domain

- **Work products examples**
  - Synopsis ✓ – skl
  - Glossary ✓ – skl
  - Assumptions
  - Status ✓ – skl

- **Success indications**
  - Work products developed
  - Lessons learned documented
    - Define variability early
    - Standardize terminologies (Synthesis/Darts)

Domain Analysis

- **Concepts:**
  - Business Case
  - Domain expertise
  - Process and product development for use by an Application Engineer

- **Examples Work Products:**

  - Domain Definition
  - Domain Specification

- **Success Indicators**

  - All success criteria were met

Navigation/Communication Domain Synopsis

NAVIGATION/COMMUNICATION ASSUMPTIONS

COMMONALITIES

...

2.5 Self test for TACAN radios have the following commonalities:
- o Each has a set of discrete events that occur over a finite amount of time.
- o There is a way to manually initiate self test.
- o Self test results in TACAN outputs being driven to predefined values.

Justification: Based on analysis of self test characteristics using 3 aircraft as examples. (T34, T44, T45).

...

VARIABILITIES

...

2.1.10 Self Test characteristics vary for each type of radio in the domain.
2.1.10.1 The ways that self test is initiated varies for each type of radio.
2.1.10.2 The duration of self test varies for each type of radio.
2.1.10.3 The characteristics that are exhibited during self test varies for each radio.
2.1.10.4 The way self test is terminated varies for each type of radio.
2.1.10.5 The interaction of TACAN/VOR self test with other systems varies for given cockpit configurations.
2.1.10.6 Self_Test may or may not exist for TACAN/VOR.

Justification: For real aircraft in the domain, detailed self test characteristics will vary.

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EXCLUSIONS

DOMAIN ASSUMPTIONS

2-71

Decision Model

- **Concepts:**
  - Basis (foundation) for the Application Engineering process
  - Distinguishes leverage reuse through identification variabilities in the form of questions
  - Basis for "tailoring" generics to specifics

- **Examples work products within the Decision Model:**
  - Decision Tables - a set of decisions representing the variability assumptions
  - Decision Group - a set of related decisions
  - Decision Constraints - Corresponds to the number of possible decisions.

- **Success indications:**
  - Work products were produced
  - Functionality was addressed
  - Lessons learned
    - Domain experts are essential
    - Design of Decision Model should be driven by how best to represent variability, not presentation format
    - Decision Groups should be kept small

TACAN Self Test Decision Variables				
AVTS.NAVCOM.RAIDS.TACAN[for each **TACAN_Crew_Locations**].SLFTST				
Entry Criteria : AVTS.NAVCOM.RAIDS.TACAN [for each **TACAN_Crew_Locations**] **TACAN_SELF_TEST_REQUIRED** Must not be FALSE				
Decision Variable	Structural Constraint	DC Ref	VA Ref	Description
Change_In_Channel_Terminate _TACAN_Self_Test	Exactly One (Yes, No)		VA_2.1.10.4	For TACAN Self Test there are several ways to terminate the self test.
Components_Affected_By_Tacan_Self_Test	Zero or More [VOR, INS, RNAV, ADF]		VA_2.1.10.5	For TACAN there may be other systems that react to a TACAN self test signal
TACAN_Self_Test_Initiated	One or More [Push and Hold, Push and Release, Power On, Other] 6		VA_2.1.10.1	For initiating self test there are several options. These options are based on the type of control unit under consideration.
TACAN_Button_Pressed_During_Self_Test	Exactly One [Restart, Terminate, Nothing]	DC_2	VA_2.1.10.1	For TACAN self test initiated by a push and type button, there is variability in the effect of pressing the button again during self test.
TACAN_Self_Test_Phases	Integer in Range [0,25]		VA_2.1.10.2	In a TACAN radio, there are a variable number of discrete events that occur during self test. Each phase is defined by a change in the characteristics of self test.

DECISION MODELS

Product Requirements

- **Concepts:**
  - Describes the product family scope & behavior
  - Describes the purpose and objective of the product family
  - Describes the relationship within the product family
  - Describes the limits of the product family
  - Products and Process Requirements can be done concurrently (and was)
- **Example work products**
  - Product Requirements Specification
- **Success indications:**
  - Functional requirements were developed
  - Requirements were developed in the time allocated
  - Work products were developed

PRODUCT REQUIREMENTS

(B)

Navigation/Communication Product Requirements

1. INTRODUCTION
2. REQUIREMENTS.
2.1 Segment Definition.
2.2 Characteristics.
2.2.1 Performance Characteristics.
2.2.1.1 Segment Modes and States.
2.2.1.2 Nav/Comm Segment Functions. The following functions shall be accomplished by the Nav/Comm segment.
2.2.1.2.1 Nav/Comm Segment Support Function.

if **Radio_Navigation_Aids** *then*
if **VHF_Nav_System** *then*
if **VHF_Nav_Self_Test_Required** *then*
There shall be a self test function for the VHF Nav system.
if **VOR_Self_Test_Initiated** (Push and Hold) *then*
The VOR self test shall simulate the characteristics of self test by pressing and holding the self test switch .
end if
end if
end if
if **TACAN_System** *then*
if **TACAN_Self_Test_Required** *then*
There shall be a self test function for the TACAN system. (C) 6
if **TACAN_Self_Test_Initiated** (Push and Hold) *then*
The TACAN self test shall be initiated by a press and hold button.
end if
end if
end if

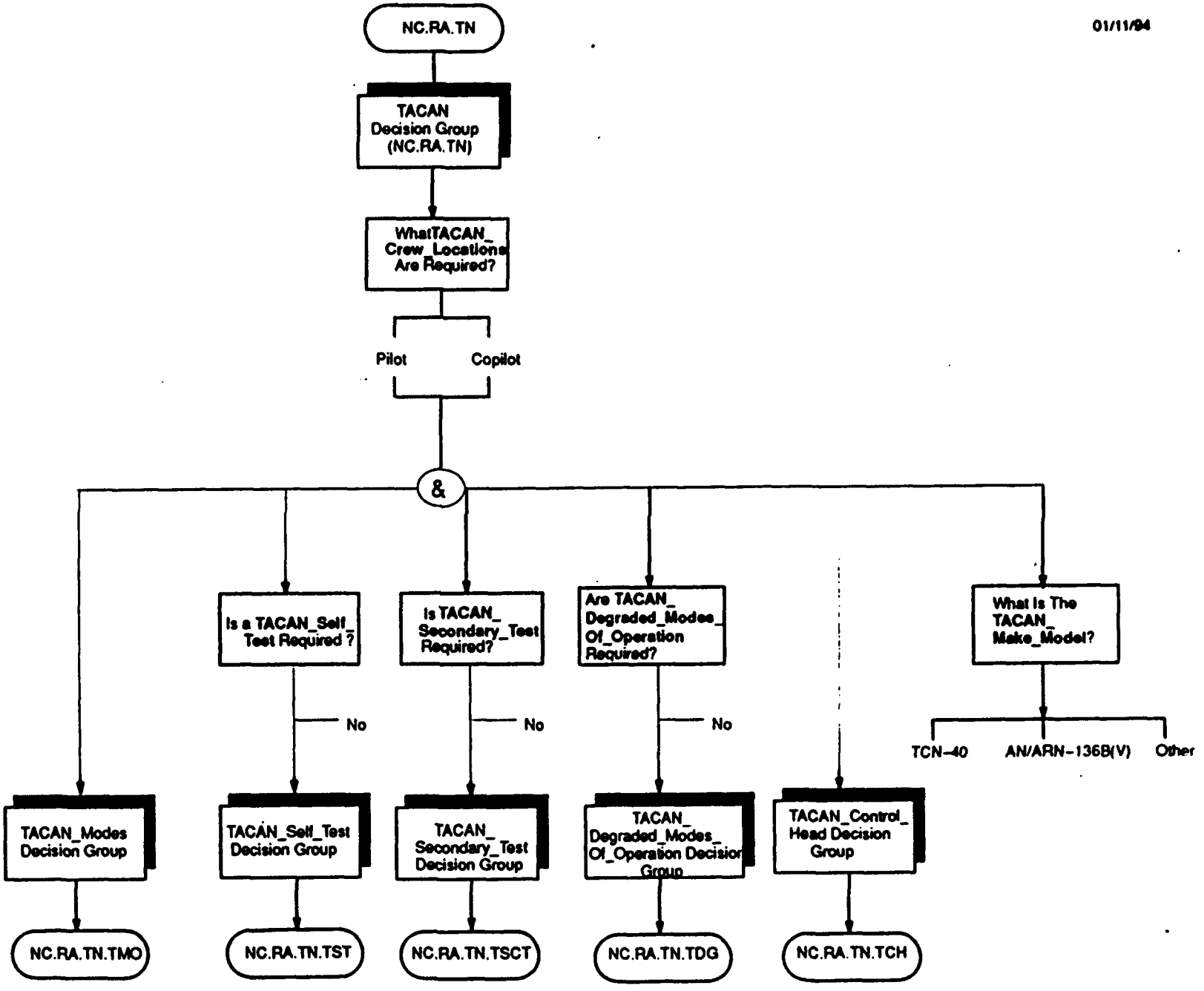
end if

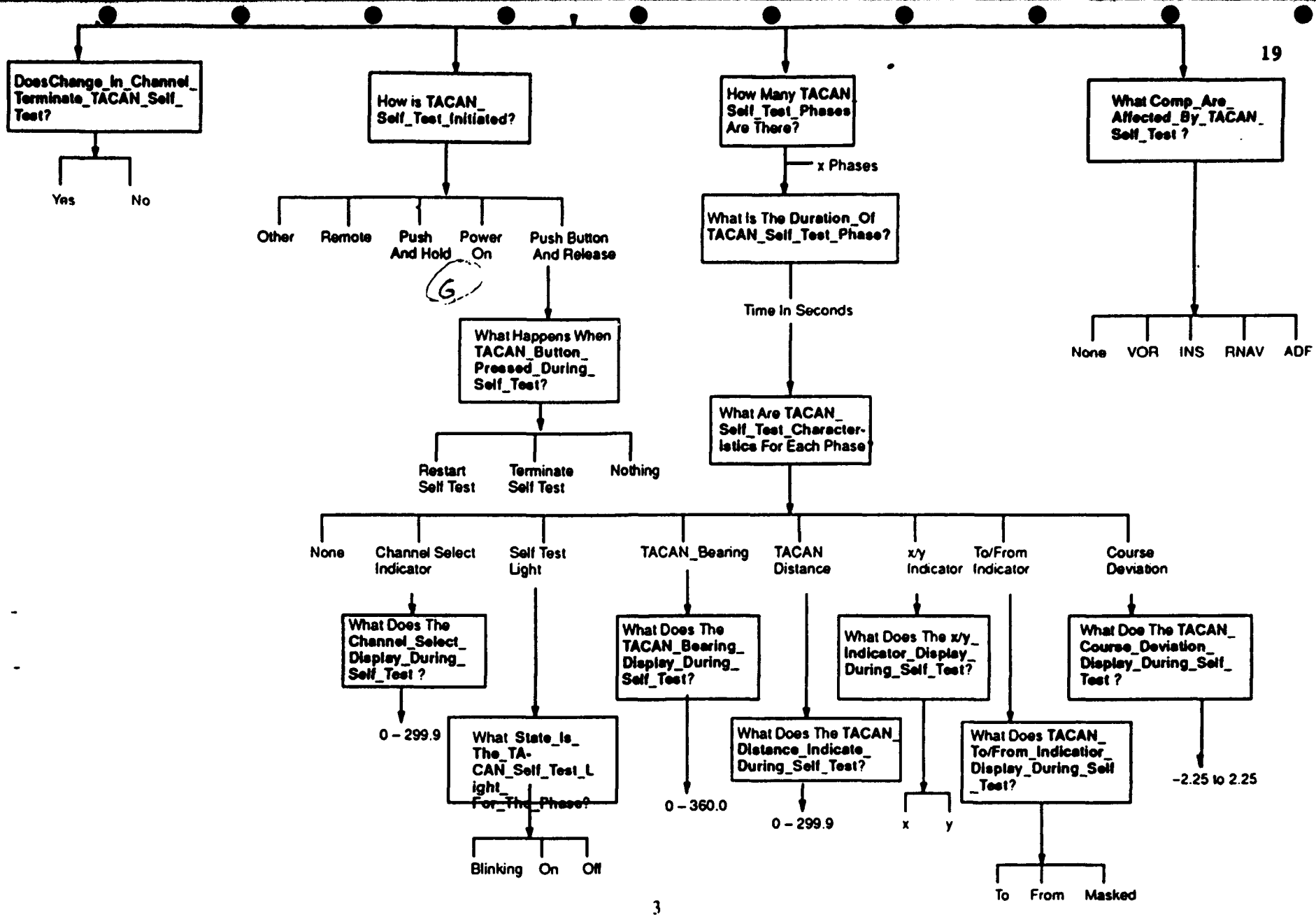
Navy/STARS Readiness Review

Process Requirements

- **Concepts:**
  - Describes the Application Engineering process
  - Describes the procedures for identifying reuse
- **Examples work product:**
  - Process Specification
  - Application Modeling Notation Specification
- **Success indications:**
  - Work products were developed
  - Application Engineering process was developed
  - Application Engineering process was documented

TACAN DECISION GROUP




Does Change_In_Channel_Terminate_TACAN_Self_Test?
Yes
No
How is TACAN_Self_Test_Initiated?
Other
Remote
Push And Hold
Power On
Push Button And Release
What Happens When TACAN_Button_Pressed_During_Self_Test?
Restart Self Test
Terminate Self Test
Nothing
How Many TACAN Self_Test_Phases Are There?
x Phases
What Is The Duration_Of TACAN_Self_Test_Phase?
Time In Seconds
What Are TACAN_Self_Test_Characteristics For Each Phase?
What Comp_Are_Affected_By_TACAN_Self_Test ?
None
VOR
INS
RNAV
ADF
None
Channel Select Indicator
Self Test Light
TACAN_Bearing
TACAN Distance
x/y Indicator
To/From Indicator
Course Deviation
What Does The Channel_Select_Display_During_Self_Test ?
0 – 299.9
What State_Is_The_TACAN_Self_Test_Light_For_The_Phase?
Blinking
On
Off
What Does The TACAN_Bearing_Display_During_Self_Test?
0 – 360.0
What Does The TACAN_Distance_Indicate_During_Self_Test?
0 – 299.9
What Does The x/y_Indicator_Display_During_Self_Test?
x
y
What Does TACAN_To/From_Indicator_Display_During_Self_Test?
To
From
Masked
What Doe The TACAN_Course_Deviation_Display_During_Self_Test ?
-2.25 to 2.25

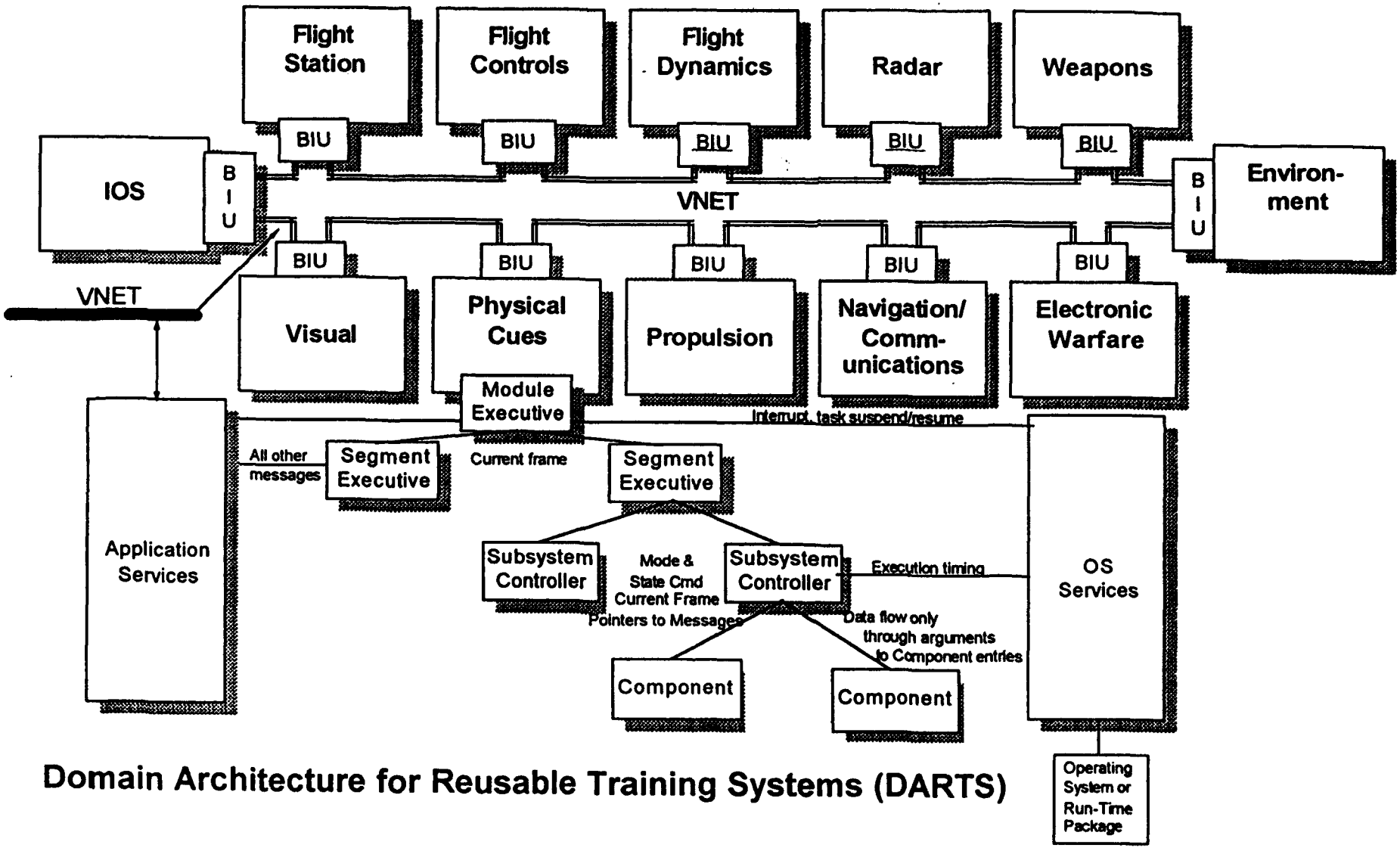
Product Design

- **Concepts:**
  - Specifies the design of the product family
  - Development of design methodologies
- **Example work products:**
  - Product Architecture
  - Component Design
  - Generation Design
- **Success Indications**
  - Work products have been developed
  - Lessons learned have been documented
    - Design methodologies are required as entrance criteria
    - Design should allow for feedback loop between component design and architecture

Navy/STARS Readiness Review

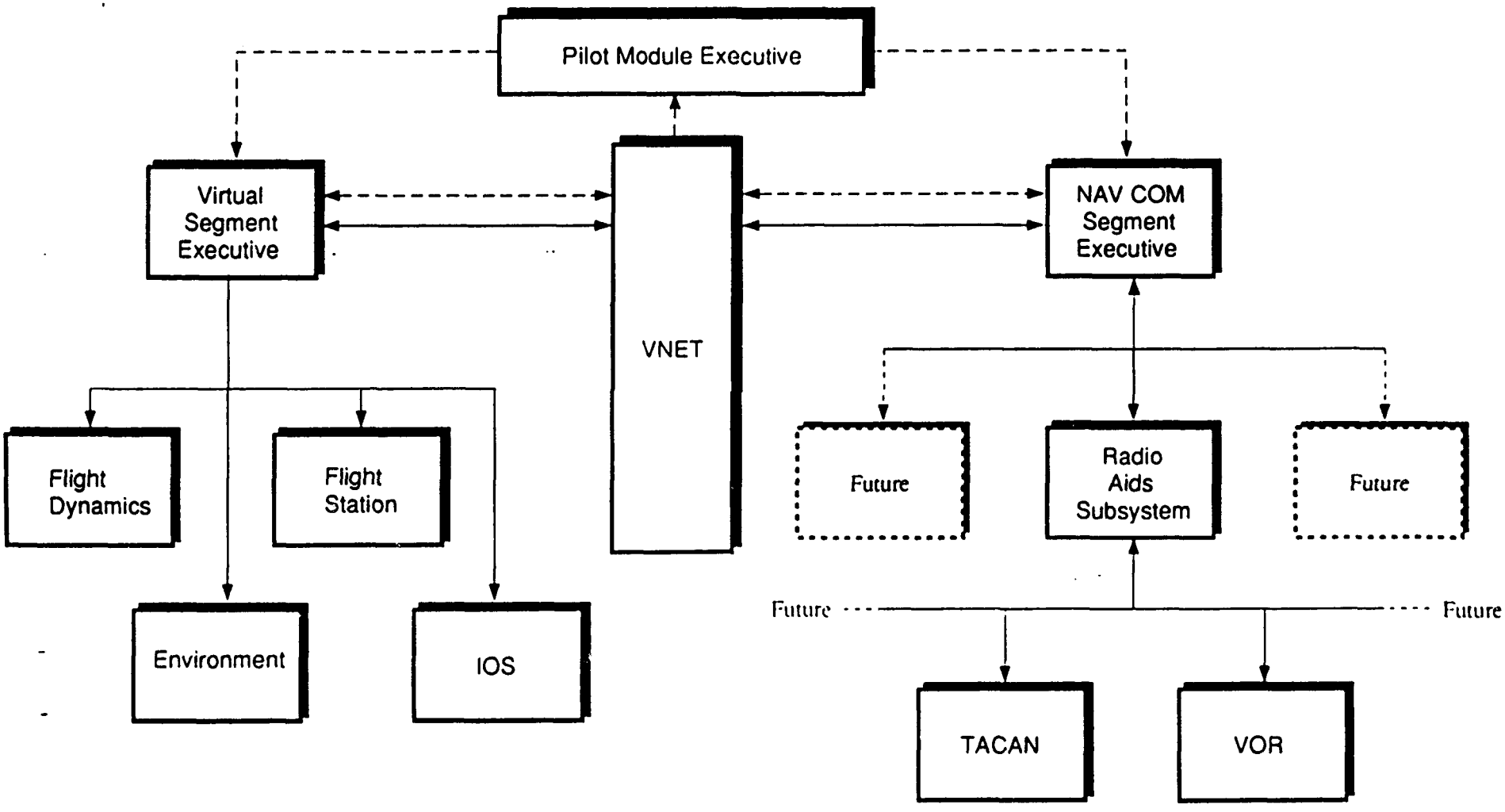
Architecture

- **Concepts:**
  - Adopted a mature architecture for the process (DARTS)
  - Supported by design methods (flow, dependency & object) developed by the team
  - AVTS (DARTS message handler) central to overall structure
- **Example work products:**
  - Product Architecture
- **Success indication:**
  - Work products have been developed
  - Lessons learned have been documented
    - Product Architecture must provide necessary levels of encapsulation
    - Product Architecture can be fine grained
    - Architecture does not necessarily match the Decision Model



Domain Architecture for Reusable Training Systems (DARTS)

Slice Simulator Architecture



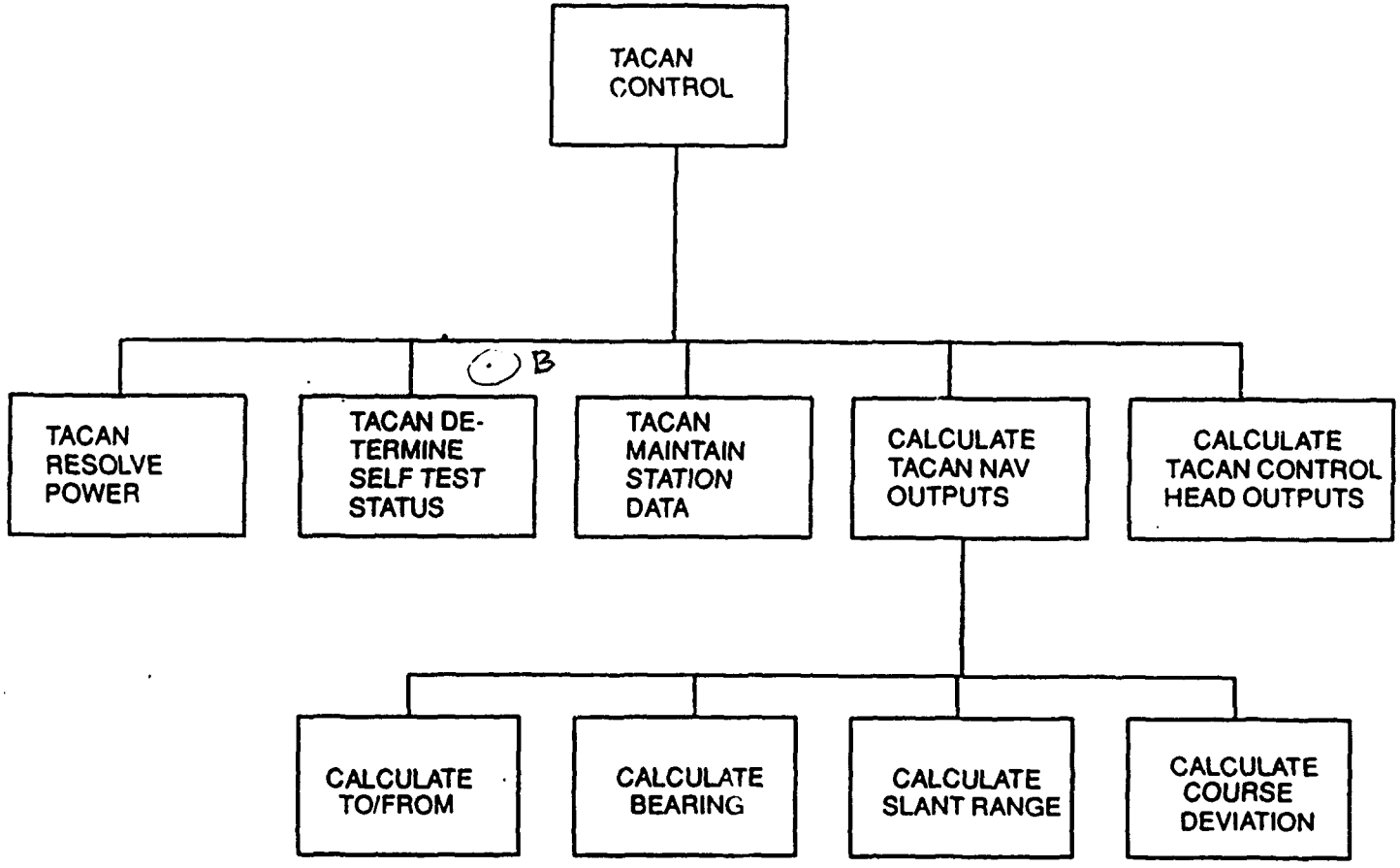


FIGURE 2.1.3 TACAN ARCHITECTURE

Component Design

- **Concept:**
  - Component design is similar to traditional design
  - Component design defines the interfaces

- **Example work products**
  - Adaptation Specification
  - Interface Specification

- **Success indications:**
  - Work products were developed
  - Lessons Learned were documented
    - Component Design effects product architecture and vice versa

```
    self_test_active = true                — set self test to active
  endif
endif G;

<else if P_TAC_ST_PUSH_AND_HOLD> — if it's a press and hold push button.
If self_test_activate = true        — Self test button pressed then
 self_Test_Activate = true          — set self test to active>
endif B

<else>
  null;   — none or other manual self test initiation
<endif>


— process self test
if self test active
 increment self_test_timer;

  — check for premature termination
  <if P_TAC_TERM_WITH_CHAN then> — if TACAN self test terminated by change in
                                 — channel.
  if change_in_channel then
   terminate_self_test
  endif
  <endif>

  <if other termination condition then>
    Terminate_self_test
 <endif>

 — now determine the phase
 phase_found = false                — initialize a flag for search loop.
 loop for each phase                  — for each phase of time that's defined in self test.
  if timer < phase end time then   — see if the timer falls into that time slot.
    phase = loop index;             — set the phase found flag
    phase_found = true              — set the phase found flag
    exit loop;
  endloop
  if phase_found = false          — if all phases have run to completion.
   terminate_self_test;
  endif

endif; — end process self test logic


procedure Terminate_Self_Test;
```

Generation Design

- **Concepts:**
  - Specifies the mapping that will produce Application Engineering work products
  - Generated Design is the adaptation of the Component Design
- **Example mappings**
  - Architecture Mapping - Decision Model-to-Architecture
  - Component Mapping - How each component of a work product is to be produce
  - Decision Mapping - Relations between Decision Model and instantiation parameters for the Component Design

- **Success indications**
  - Work products were developed
  - Lessons learned were documented
    - Process support is required

P_INITIATE_PUSH_AND_HOLD	if (Push_and_Hold ∈ %loc%_%inst%_%tst%_Test_Initiated) then TRUE else FALSE
P_INITIATE_REMOTE	if (Remote ∈ %loc%_%inst%_%tst%_Test_Initiated) then TRUE else FALSE
P_AFFECT_OF_ REPRESS_RESTART	if (%loc%_%inst%_Button_Pressed_During_%tst%_Test = Restart) then TRUE else FALSE
P_AFFECT_OF_ REPRESS_TERMINATE	if (%loc%_%inst%_Button_Pressed_During_%tst%_Test = Terminate) then TRUE else FALSE
P_AFFECT_OF_ REPRESS_NO_EFFECT	if (%loc%_%inst%_Button_Pressed_During_%tst%_Test = Nothing) then TRUE else FALSE
P_ST_FAIL	if (Self_Test_Fail ∈ TACAN_Malfunctions) then TRUE else FALSE

DECISION MAPPING

Generation Design

Architecture Map – provides the mapping between the architecture nodes and the instantiation parameters. This defines what architectural nodes are required given an application model (instance of the domain).

NAV/COMM Segment Exec
If Navigation_Communication_System = Yes

Radio Navigation Aids
If Radio_Navigation_Aids = Yes

Pilot TACAN Control
If TACAN_Systems = Yes and {Pilot is an element of TACAN_Crew_Locations}

Pilot TACAN Resolve Power
If TACAN_Systems = Yes and {Pilot is an element of TACAN_Crew_Locations}

Pilot TACAN Determine Self Test Status
If Pilot_TACAN_Self_Test_Required = Yes

Pilot TACAN Maintain Station Data
If TACAN_Systems = Yes and {Pilot is an element of TACAN_Crew_Locations}

Calculate Pilot TACAN Nav Outputs
If TACAN_Systems = Yes and {Pilot is an element of TACAN_Crew_Locations}

Calculate Pilot TACAN Control Head Outputs
If TACAN_Systems = Yes and {Pilot is an element of TACAN_Crew_Locations}

Pilot VOR Control
If VHF_Nav_System = Yes and {Pilot is an element of VOR_Crew_Locations}

Pilot VOR Resolve Power
If VHF_Nav_System = Yes and {Pilot is an element of VOR_Crew_Locations}

Pilot VOR Determine Self Test Status
If Pilot_VHF_Nav_Self_Test_Required = Yes

Pilot VOR Maintain Station Data
If VHF_Nav_System = Yes and {Pilot is an element of VOR_Crew_Locations}

Calculate Pilot VOR Nav Outputs
If VHF_Nav_System = Yes and {Pilot is an element of VOR_Crew_Locations}

Calculate Pilot VOR Control Head Outputs
If VHF_Nav_System = Yes and {Pilot is an element of VOR_Crew_Locations}

ARCHITECTURE MAPPING

COMPONENT MAPPING

Component Map – provides the mapping between the architectural nodes and the adaptable components that fill the node.

NAV/COMM Segment Exec
Use Component: Package, Navigation_Communication_Executive

Radio Navigation Aids
Use Component: Package, Radio_Nav_Aids_Subsystem_Controller

Pilot TACAN Control
Use Component: Package, TACAN

Pilot TACAN Resolve Power
Use Component: Procedure, TACAN_Resolve_Power

Pilot TACAN Determine Self Test Status
Use Component: Package, Self_Test

Pilot TACAN Maintain Station Data
Use Component: Procedure, Maintain_Station_Data

Calculate Pilot TACAN Nav Outputs
Use Component: Procedure, TACAN_Nav_Outputs

Calculate Pilot TACAN Control Head Outputs
Use Component: Procedure, TACAN_Control_Head_Outputs

Pilot VOR Control
Use Component: Package, VOR

Pilot VOR Resolve Power
Use Component: Procedure, VOR_Resolve_Power

Pilot VOR Determine Self Test Status
Use Component: Package, Self_Test

Pilot VOR Maintain Station Data
Use Component: Procedure, Maintain_Station_Data

Calculate Pilot VOR Nav Outputs
Use Component: Procedure, VOR_Nav_Outputs

Calculate Pilot VOR Control Head Outputs
Use Component: Procedure, VOR_Control_Head_Outputs

Navy/STARS Readiness Review

Domain Implementation

- **Key activities:**
  - Product Implementation
    - Component Implementation
    - Generation Implementation
  - Process Support Development

- **Success indication:**
  - Work products have been developed
  - Application Engineering process was documented
  - Application Engineering process was developed
  - Application Engineering process exacted in SEE
  - Lessons learned were documented
    - ADA skills are required

Component and Generation Implementation

- **Concepts:**
  - Implement components with variables as instantiation parameters
  - Create automated processes to:
    - Capture variations as questions
    - Retrieve and adapt components
- **Examples:**
  - Adaptable components
  - Generation procedures
- **Success indications**
  - Work products have been developed
  - Application Engineering process has been developed
  - Lessons learned have been documented
    - Generation Implementation should be performed by a process engineer

```
(deffunction make-TACANSelfTest (?spawninst ?value)

    (if (eq ?TACAN_C_answer_value Yes) then
      (bind ?value Copilot)
      (bind ?nvalues (+ ?nvalues 1) )
    )
    (if (eq ?TACAN_P_answer_value Yes) then
      (bind ?value Pilot)
      (bind ?nvalues (+ ?nvalues 1) )
    )

    .
    .
    .
    .

    (bind ?newsym  (sym-cat ?value "TACSlfTestInit"))
    (bind ?newdesc (str-cat ?value "TACSlfTestInit"))

    (bind ?newnam  (symbol-to-instance-name ?newsym))
    (bind ?qnewsym (sym-cat ?newsym "Question"))
    (bind ?qnewnam (symbol-to-instance-name ?qnewsym))

    (make-instance ?newnam of MULTI_DECISION
      (Design_Group_ID TACANSelfTest)
      (Question_Name ?qnewsym)
      (One_Line_Desc ?newdesc)
      (InstanceInstantiatedBy ?spawninst)
      (FurtherQFunction make-buttonpress)
      (Multi_Entry      nil))
    (make-instance ?qnewnam of MULTIPLE_CHOICE_QUESTION
      (Decision_Name ?newsym)
      (Question (format nil "%s%s%n%s" "How is " ?value
       "TACAN self test Initiated ?"))
      (One_Line_Question ?newdesc)
      (Text_Choices Push_And_Hold Power_On Push_And_Release Other)
      (Choices      Push_And_Hold Power_On Push_And_Release Other)
      (Lines_Selected  0)
      (Decision_Help_Text (format nil "%s%n%s%n%s"
       "For initiating self test there are"
       "several options. These options are based on "
       "the type of control unit under consideration"))

    .
    .
    .
```

KAMEL MAKE FUNCTION

DECIDE SCREEN

2-15 T

File Actions Help

How is Pilot
TACAN self test initiated ?

- [ ] Push_And_Hold
- [ ] Push_And_Release
- [ ] Power_On
- [ ] Other

```
Malfunctions : Yes
BackdoorInterface : No
Diagnotics/Test : No
Segment--Occulting : Environment
Segment--RadarDB/GA : None
Segment--VisualDB/GA : None
Segment--SpatialRels : Environment
Scoring : No
Autotest Capab. : No
Reposition Capab. : Yes
Motion Fidelity : 6_DOF
Engine Type : Turbine
Air Vehicle Class : Airplane
Training Sys Name : Flight Instrument
```

```
Tacan Self Test Decision Group : Enacl
PilotTACSlfTestTerm : No
```

Accept | Decision Help | Re-Decide

2-15

```
   (bind ?tests_a (create$ TAC TAC VOR VOR))
   (bind ?tests_b (create$ Slf Sec Slf Sec))
   (bind ?tests_c (create$ SELF SECONDARY SELF SECONDARY))
35 (bind ?tests_d (create$ TACAN TACAN VOR VOR))

   (while (<= ?testtype 4 )

     (bind ?ta1 (nth ?testtype ?tests_a))
     (bind ?tb1 (nth ?testtype ?tests_b))

     .
     .
     .
     .

;-*-   Check for initiate at: power on, push & release, push &hold

     (bind ?testinit     (sym-cat "Pilot" ?ta1 ?tb1 "TestInit"))
     (bind ?testinitinst (symbol-to-instance-name ?testinit ))
     (bind ?testinitans  (send ?testinitinst get-Multi_Entry ))

     (if ( member Power_On ?testinitans ) then
       (bind ?P_INITIATE_AT_POWER_ON TRUE )
     else
       (bind ?P_INITIATE_AT_POWER_ON FALSE )
     )

     (if ( member Push_And_Release ?testinitans ) then
       (bind ?P_INITIATE_PUSH_AND_RELEASE TRUE )
     else
       (bind ?P_INITIATE_PUSH_AND_RELEASE FALSE )
     )

     (if ( member Push_And_Hold ?testinitans ) then
       (bind ?P_INITIATE_PUSH_AND_HOLD TRUE )
     else
       (bind ?P_INITIATE_PUSH_AND_HOLD FALSE )
     )

     .
     .
     .

     (format ?where "%s%s%n" "  ADAPT $P_INITIATE_PUSH_AND_HOLD$   "
                                ?P_INITIATE_PUSH_AND_HOLD )

     .
     .
     .
```

KAMEL RETRIEVE FUNCTION

36

1 APPLICATION MODEL/DECISION–VECTOR

1.1 Decision Group : TACAN_SELF_TEST

- PilotTACSlfTestTerm = No
- PilotTACSlfTestInit = **Push_And_Hold**
- PilotTACSlfTestPhases = 1
- PilotTACCompAffect = VOR
- PilotTACSlfPhase1Ch = Channel_Select_Indicator X/Y_Indicator
- PilotTACSlfPhase1ChChSlIn = 188.0
- PilotTACSlfPhase1ChXYInd = X

Navy/STARS Readiness Review

Process Support Development

- **Concepts:**
  - Translates and "load" Domain Engineering work products in the SEE
  - Procedural standards

- **Example Work Products**
  - Application Engineering Process Standards
  - Application Engineering User's Guide
  - Applicaton Engineering Environment
  - Application Engineering Environment Support Manual
  - Application Engineering Training Course

- **Success indications**
  - Application Engineering process has been enacted in the SEE
  - Lessons learned have been documented
    - SEE enactment process must be mature to be followed properly

```
Determined_Active := false;

-- Look at TACAN power. Dont execute if power is off.
if Power = On then

  --$-- Include if auto self test at power up.
  --$if SP_INITIATE_AT_POWER_ON$ THEN
  if New_Power = base_types.true then
    Determined_Active := true;
  end if;
  --$end IF

  --$-- Include if type is push and release
  --$if SP_INITIATE_PUSH_AND_RELEASE$ THEN
  if Test_Activate = On then  -- if "button" is currently pressed.
    Determined_Active := true;

    --$-- Include if button restarts the test if test is already running.
    --$if SP_AFFECT_OF_REPRESS_RESTART$ THEN
      if Last_Pass_Active then   -- if self test is active
        Timer := 0.0;            -- reset timer.
      end if;
    --$end IF;

    --$if SP_AFFECT_OF_REPRESS_TERMINATE$ THEN
      if Last_Pass_Active then   -- if self test is active
        Determined_Active := false; -- Deactivate Self Test.
      end if;
    --$end IF;

  else
    -- if active from last pass let the timer terminate the test.
    if Last_Pass_Active then  -- if active from last pass let
      Determined_Active := true;
    end if;
  end if;
  --$end IF

  --$-- Include if type button is push and hold.
  --$if SP_INITIATE_PUSH_AND_HOLD$ THEN
  if Test_Activate = On then
    Determined_Active := true;
  else
    Determined_Active := false;
  end if;
  --$end IF

  --$-- Include if change in channel interupts self test
  --$if SP_TERM_WITH_CHANS THEN
  if Change_In_Channel then
    Determined_Active := false;
  end if;
  --$end IF

  if Determined_Active then

    -- If first pass of a self test then initialize timer.
    if not Last_Pass_Active then
      Timer := 0.0;
    end if;

    -- Increment self test timer.
    Timer := Timer + Iteration_Duration;

    -- Search phase end time array to determine what phase self test is in
    for I in 1..Num_Phases loop
```

ADAPTABLE CODE

ROAMS RETRIEVE FILE


```
-- SELF_TEST retrieve file

begin

   ADAPT $P_PACKAGE_TEST_NAME$              DETERMINE_TACAN_SELF_TEST
   ADAPT $P_PROCEDURE_TEST_NAME$            PROCESS_TACAN_SELF_TEST
   ADAPT $P_TERM_WITH_CHAN$                 FALSE
   ADAPT $P_EXTERNAL_OUTPUTS$               TRUE
   ADAPT $P_NUM_PHASES$                     "1"
   ADAPT $P_END_TIME_OF_PHASES$             "0.0"
   ADAPT $P_INITIATE_AT_POWER_ON$           FALSE
   ADAPT $P_INITIATE_PUSH_AND_RELEASE$      FALSE
   ADAPT $P_INITIATE_PUSH_AND_HOLD$         TRUE
   ADAPT $P_AFFECT_OF_REPRESS_RESTART$      FALSE
   ADAPT $P_AFFECT_OF_REPRESS_TERMINATE$ FALSE
   ADAPT $P_AFFECT_OF_REPRESS_NO_EFFECT$ FALSE
   ADAPT $P_ST_FAIL$  FALSE

   COPY type SELF_TEST_BODY_A. TACAN_SELF_Test.adb
   COPY type SELF_TEST_SPEC_A. TACAN_SELF_Test.ads

end
```

```
-- Declare variables required within package.
   -- Number of phases
   Num_Phases : Base_Types.Signed_Integer_16 := 1;
   Phase : Base_Types.Signed_Integer_16 := 0;
   Iteration_Duration : float_32 := 0.1;

   Timer : float_32 := 0.0;
   Last_Pass_Active : boolean := false;
   Test_Active : Base_Types.Discrete_State;

-- Define and initialize array that contains end times for each self test phase.
-- These are elapsed time from self test initiation that each phase will
-- terminate.

   type float_array is array (Base_Types.Signed_Integer_16 range <>) of float_32;
   Phase_End_Time : float_array (1..1)
      :=(
    1=>
   0.0);

procedure PROCESS_TACAN_SECONDARY_TEST(

-- Declare variables for this procedure

   Test_Activate : in Base_Types.Discrete_State;
   Power : in Base_Types.Sim_Boolean;
   New_Power : in Sim_Boolean;


   External_Test_Out: out Base_Types.Discrete_State;


   Test_Phase     : out Base_Types.Signed_Integer_16) is

-- Declare and initialize local variables.

Phase_Found : Boolean := false;       -- Phase Found flag.
Determined_Active : Boolean := false;

begin

-- Initialize some variables.
Phase_Found := false;
Determined_Active := false;

-- Look at TACAN power. Dont execute if power is off.
if Power = True then


   if Test_Activate = On then
     Determined_Active := true;
   else
     Determined_Active := false;
   end if;


   if Determined_Active then

     -- If first pass of a self test then initialize timer.
     if not Last_Pass_Active then
       Timer := 0.0;
     end if;

     -- Increment self test timer.
```

ADAPTED CODE

Rockwell International

Command and Control Systems Division

Synthesis Pilot Project

Presented by
Jerri Turner–Harris

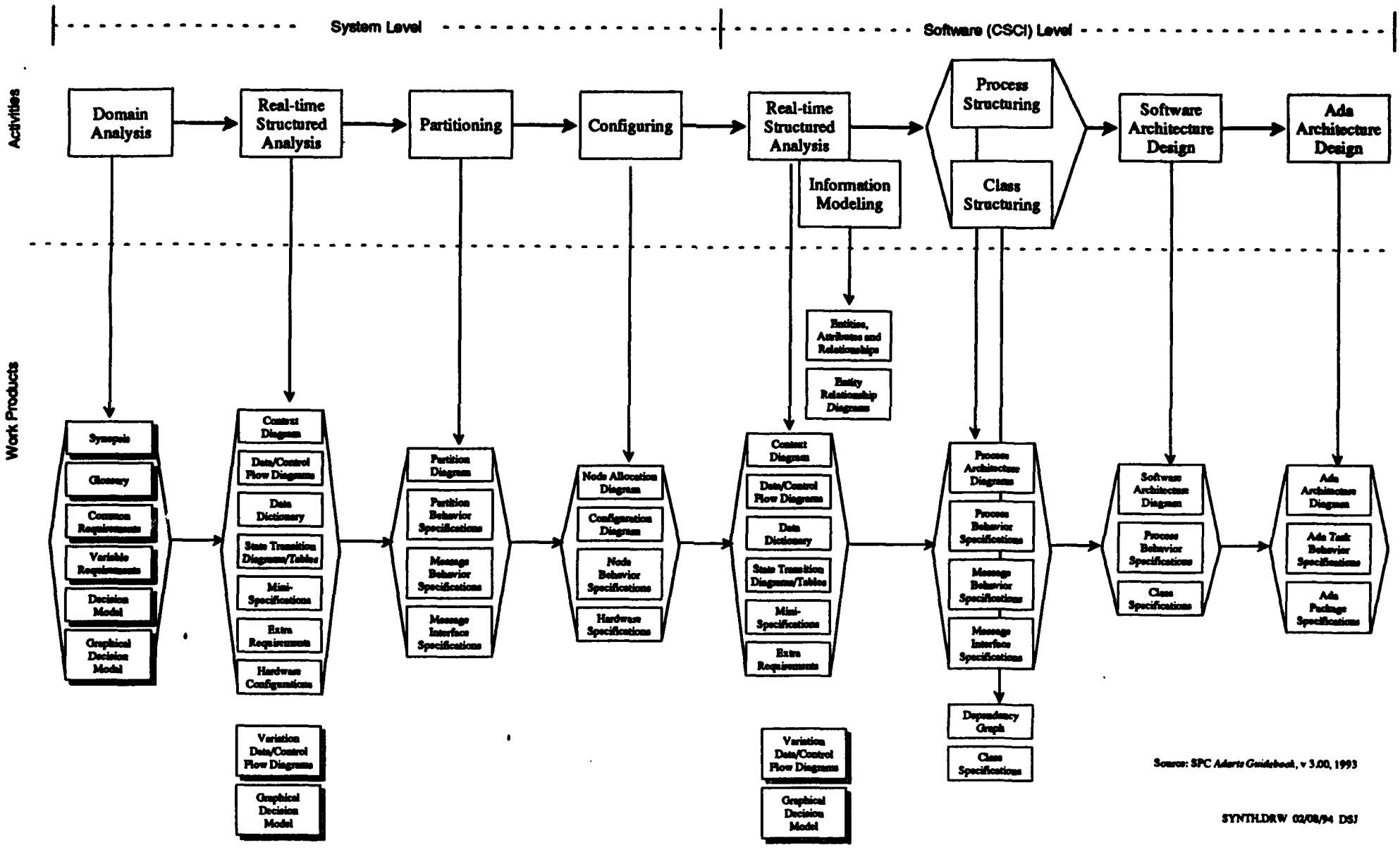
DOMAINS / SUBDOMAINS

- COMMUNICATIONS MANAGEMENT AND CONTROL DOMAIN
- MIL-STD-1553B INTERPROCESSOR COMMUNICATION SUBDOMAIN
- MESSAGE HANDLING SYSTEM DOMAIN

LESSONS LEARNED

- ADOPT DISCIPLINED METHODS
  - REAL-TIME STRUCTURED ANALYSIS
  - ADARTS
  - CODING AND DOCUMENTATION STANDARDS
  - METRICS
- COMMUNICATE DOMAIN EXPERIENCE
  - PRODUCT REVIEWS
- USE AVAILABLE AUTOMATED TOOLS
  - OPENSELECT
  - TEAMWORK
  - WORDPERFECT MACRO AND MERGE
  - TRF

The Role of ADARTS in Domain Analysis



Synopsis Segment

Subdomain implementations provide error free application to application communications by MIL-STD-1553B bus. Subdomain implementations may provide 1553B bus control, 1553B remote terminal and 1553B bus monitoring functions.

Commonality

Every MHS will periodically delete expired messages from storage.

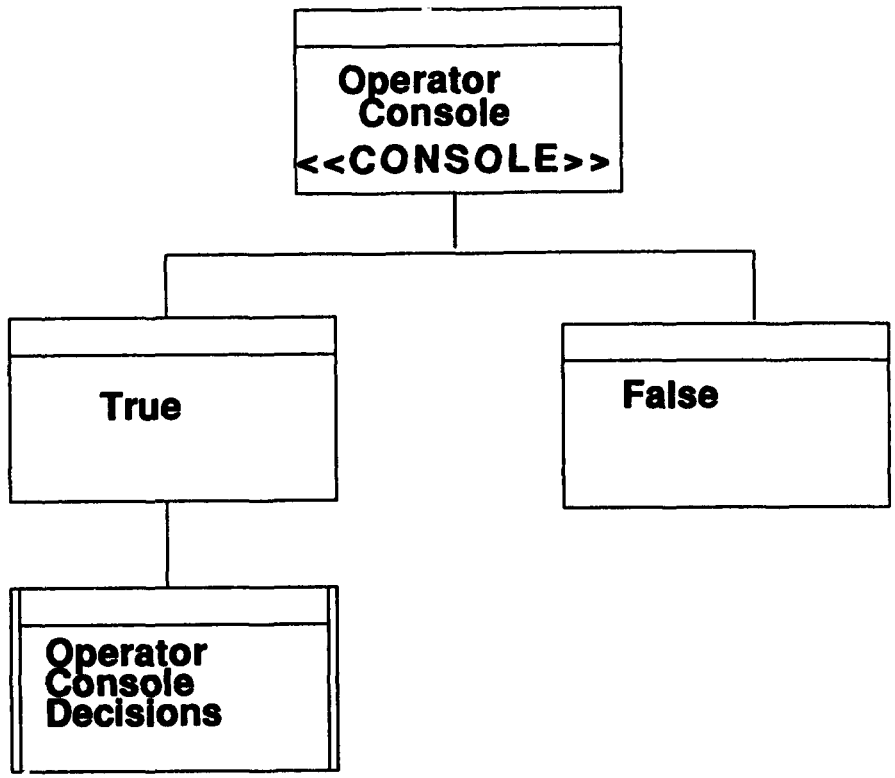
Variability

- How long a message can be stored.
- How often will storage be checked for expired messages.
- What time will storage be checked.

Decision Model

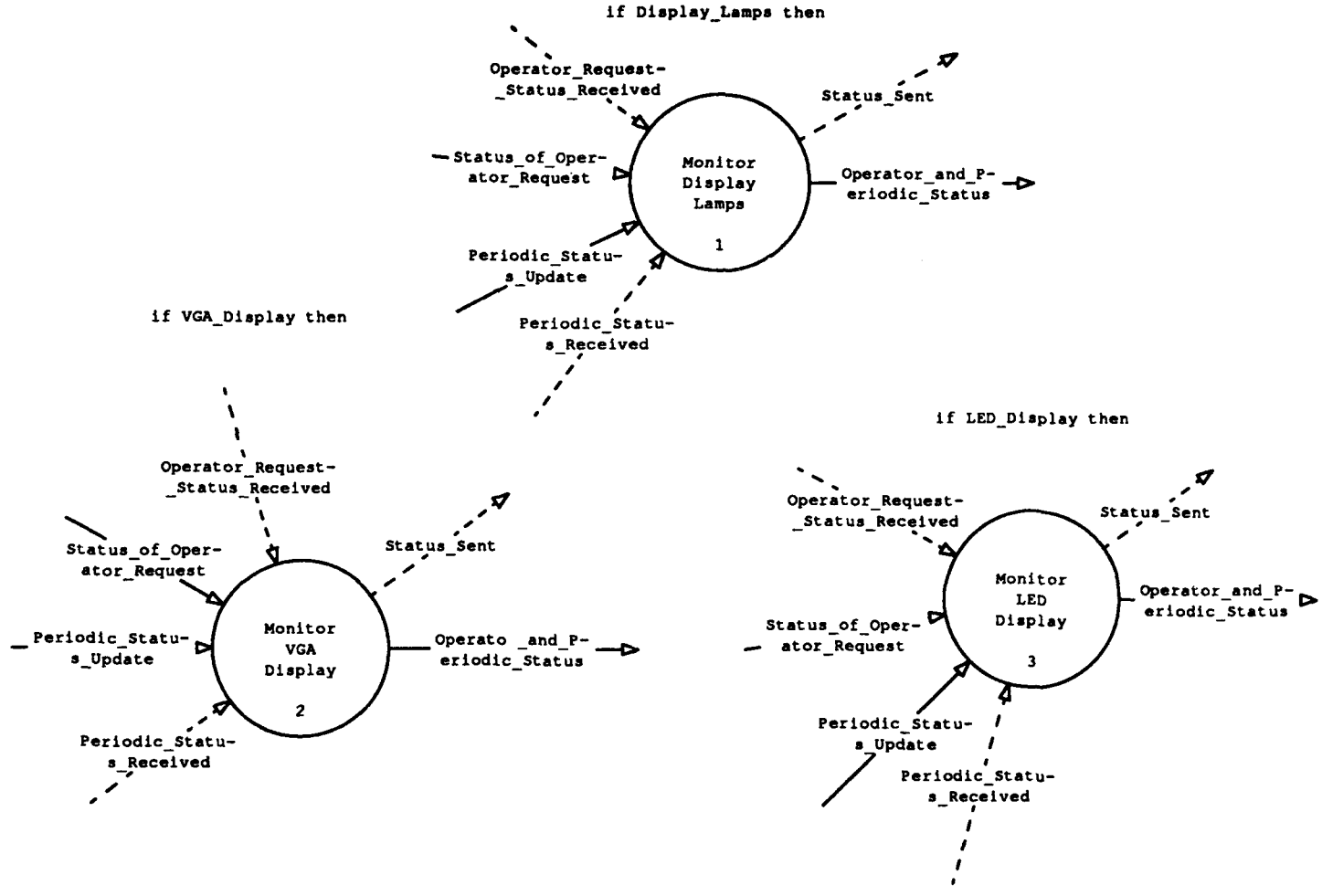
Description	Decision	Mnemonic
How long a message can be stored.	selection of (7 days, 30 days, 60 days, 90 days)	[STORAGE_LENGTH]
How often will storage be checked for expired messages.	selection of (once a day, once a week, once a month)	[STORAGE_CHECK]
What time will storage be checked.	[(1:00..12:00)] selection of (am, pm)	[STORAGE_TIME] [STORAGE_AM_PM]

Graphical Decision Model Segment



Output Display

Variation Diagram
(non-deliverable)

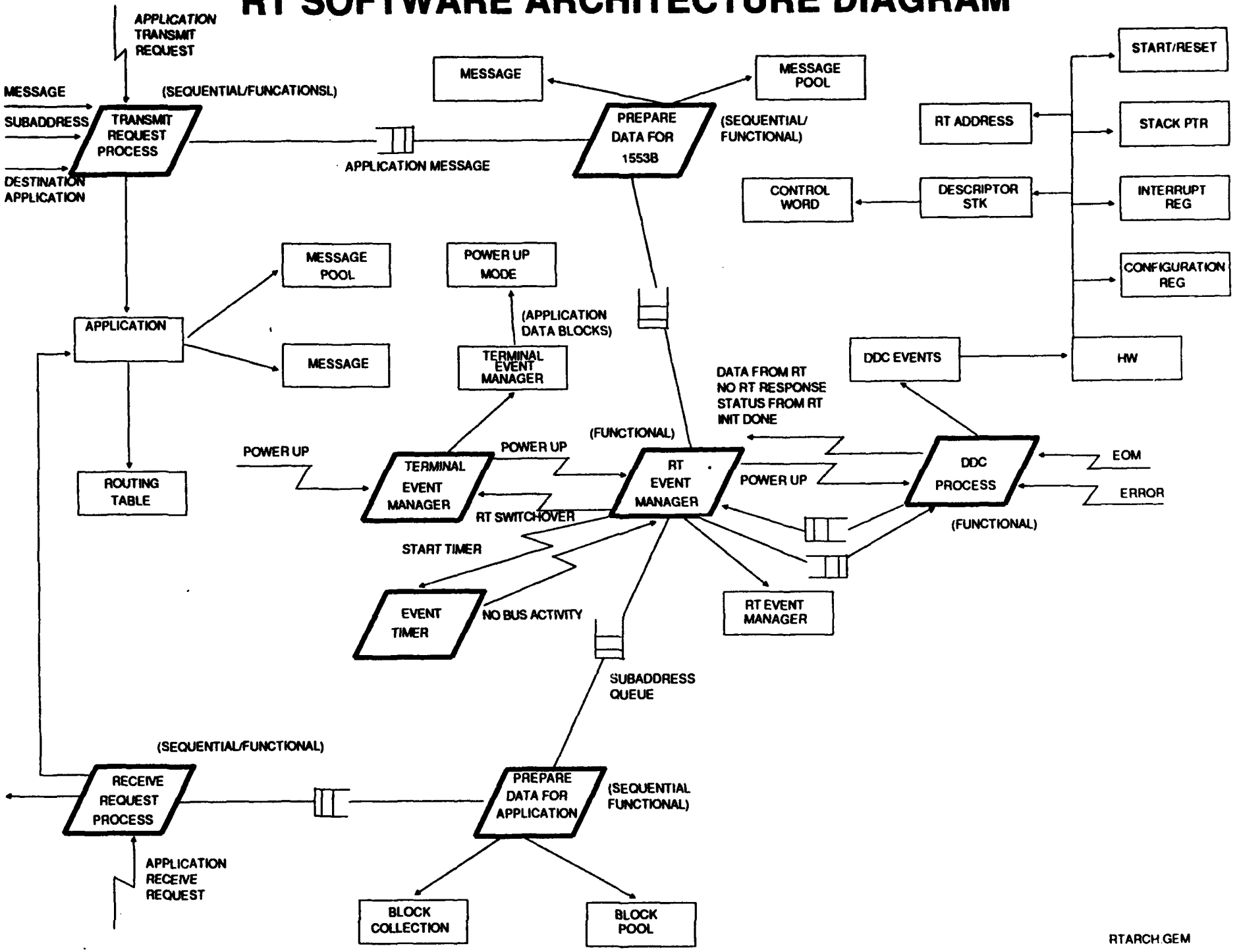


disply12.dat

Update Console

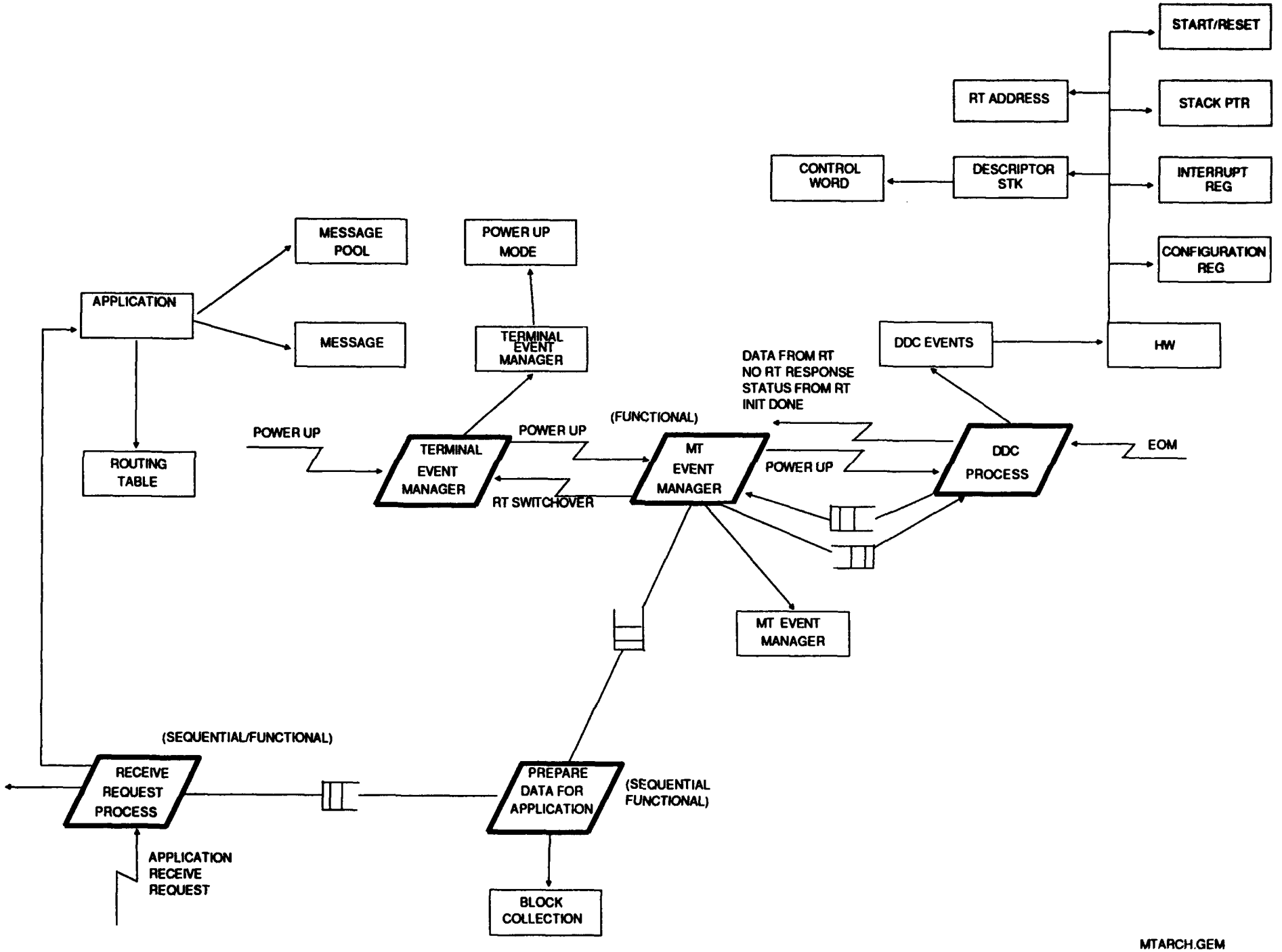
r

RT SOFTWARE ARCHITECTURE DIAGRAM



RTARCH.GEM

MT SOFTWARE ARCHITECTURE DIAGRAM



MTARCH.GEM

Terminal Information

1. Terminal Indentifier
2. Terminal a
3. Role
4. Redunda
5. Broadcast
6. Processor
7. Ram
8. Rom
9. 1553B chip
10. Interface
11. Diagnosti
12. Bus Assignment
13. Polling Sequence
14. Save Terminal

Bus Controller (BC)
Remote Terminal (RT)
Bus Monitor
BC/RT
Backup BC/RT

us Controller (BC)
ual
o
tel 80186
4
4
T1553B BCRT
hared Memory
>>>
>>>
0

Enter Selection:

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