This document presents in schematic form a systems approach for the development of an executive information system. Although it does not use the traditional sentence and paragraph form, its diagrams, written in a sequence similar to computer programs, cover such topics as history of information systems, requirements analysis, how to begin building the system, organizational context, system goals, output tracing, data collection, system design and planning, and operational use and improvement. Some discussion of the usefulness of electronic data processing and hardware acquisition is provided. (TT)
A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT OF AN EXECUTIVE INFORMATION SYSTEM

by

J. A. Evans

June 1968

This paper has been especially prepared for distribution to the California Educational Administrators participating in the "Executive Information Systems" Unit of Instruction as part of the instructional program of OPERATION PEP (Prepare Educational Planners).

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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1955
D.P. SERVICES APPROACH

INTER-SYSTEM INTEGRATION APPROACH

PRAGMATIC APPROACH

MILITARY SYSTEM APPROACH

"COSMO" APPROACH

?
A FRAMEWORK FOR
THE EVOLUTIONARY
DEVELOPMENT OF
EXECUTIVE INFORMATION
SYSTEMS
EXECUTIVE INFORMATION SYSTEMS  A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

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• GENERAL FRAMEWORK

• BASIC TYPES OF EFFORT
  1. REQUIREMENTS ANALYSIS
  2. SYSTEM DESIGN & PLANNING
  3. DEVELOPMENT, TEST & EVALUATION
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  5. OPERATIONAL USE & IMPROVEMENT
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**REQUIREMENTS ANALYSIS**

- **CONSTRAINTS AND FOCUS**
  STEPS 1, 2

- **OPERATIONAL ENVIRONMENT & MISSION**
  STEPS 3, 4

- **FUNCTIONAL ANALYSIS**
  STEPS 5, 6, 7

- **SPECIFICATION PRODUCTS**
REQUIREMENTS ANALYSIS - STEP 1

KNOW THE CONSTRAINTS

- LOCUS OF INITIATIVE
- MANAGEMENT VIEW OF PROBLEMS
- TIME AND LEVEL OF EFFORT
- TYPE AND EXTENT OF COOPERATION
- EXISTING SYSTEMS
- LONG-RANGE/SHORT RANGE BIAS
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

HOW TO BEGIN
REQUIREMENTS ANALYSIS - STEP 2

SET ORGANIZATIONAL LEVEL FOCUS

- SELECT LEVEL
- IDENTIFY KEY ELEMENTS
- ASCERTAIN KEY ACTIVITIES
WHERE TO START

RESPONSIBILITIES

PROBLEMS

EXECUTIVE
INFORMATION SYSTEMS
A FRAMEWORK FOR THE
EVOLUTIONARY DEVELOPMENT
### Requirements Analysis - Step 3

**Learn the Operational Environment**

- Organizational Context
- Task-Responsibility Alignments
- Major Processes & Decisions
- External Context
- Correlate: Context-Elements-Activities
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

SUPERINTENDENT

CABINET

PLANNING CONTROL EVALUATION

PERSONNEL

INSTRUCTIONAL

BUSINESS (OPERATIONS)

BUSINESS (FINANCIAL)

RECRUITMENT
TESTING
EVALUATION
ASSIGNMENT
EDUCATION
ORIENTATION

I.M.
PUPIL-PERS.
CURRICULUM
LIBRARY
PROGRAMS

MAINT.
CONSTR.
TRANSP.
CAFETERIA
INVENTORIES

ACCNT’G.
PAYROLL
PURCH.
PAYABLES
EXECUTIVE INFORMATION SYSTEMS
A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

REQUIREMENTS ANALYSIS - STEP 4

PERFORM "MISSION" ANALYSIS

- "ULTIMATE" GOALS
- DEFINABLE OBJECTIVES
- INTERRELATIONSHIPS AMONG OBJECTIVES
  PRIORITIES
  HIERARCHIES
- CORRELATE: OBJECTIVES-ORGANIZATION-ACTIVITIES
A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT OF INFORMATION SYSTEMS

GOALS-FUNCTIONS-ACTIVITIES

GOAL #1

FUNCTION

FUNCTION

FUNCTION

ACTIVITY

ACTIVITY

ACTIVITY

INFORMATION SYSTEM
## System Analyst's Dilemma

**Real-World Goals**
- Multiple
- Complex
- Undefined
- Controversial

**Goals for Design Guidance**
- Simple
- Clearly Related
- Precisely Defined
- Non-Controversial

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**Executive Information Systems**

A Framework for the Evolutionary Development
EXECUTIVE INFORMATION SYSTEMS | A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

REQUIREMENTS ANALYSIS - STEP 5

PERFORM "FUNCTIONAL" ANALYSIS

- PROBE THE OPERATIONAL SYSTEM
- TRACE THE DEVELOPMENT OF MAJOR OUTPUTS
- INTERVIEW KEY AND COLLATERAL PERSONNEL
- DEVELOP PATTERN OF MAJOR DECISIONS / ACTIONS
- CORRELATE: OBJECTIVES, FUNCTIONS, ORGANIZATION, ACTIVITIES
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

EXAMPLE: MAJOR OUTPUT TRACING—A PLAN

ENVIRONMENT ANALYSIS → PLANNING

RESOURCE MANAGEMENT

CURRICULUM PLAN FLOW PROCESS

(ACTIVITIES)

EVALUATION

EXECUTION & CONTROL

(TASKS)

PLANNING

PERIODIC CURRICULUM PLAN FLOW PROCESS

(INTERNAL ENVIRONMENTAL ACTIVITIES)
EXECUTIVE
INFORMATION SYSTEMS

A FRAMEWORK FOR THE
EVOLUTIONARY DEVELOPMENT

REQUIREMENTS ANALYSIS - STEP 6

PROBLEM/SOLUTION HANDLING

- OPERATIONAL SYSTEM "PROBLEMS"
- INFORMATION SYSTEM "PROBLEMS"
- SYMPTOMS OF SICK SYSTEMS
- UNRAVELLING "PROBLEM - SOLUTION" SNARLS
EXECUTIVE INFORMATION SYSTEMS  A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

PROBLEMS

TASKS/ACTIVITIES

TEDIOUS — DATA VERIFICATION, COMPUTATION
ROUTINE — SIMPLE COMPUTER AIDS
TIME CONSUMING — DATA COLLECTION, MANAGEMENT DISTRIBUTION, IR AIDS
COMPLEX — DATA ANALYSIS, "WHAT-IF" SIMULATION AIDS

IMPACT ON OPERATIONAL SYSTEM

HOW RELATED?

BUSINESS/EDUCATIONAL OBJECTIVES
INFORMATION SUBSYSTEM
ACTIVITIES
TASKS

"BRAINSTORM"

CLARIFICATION RELATIONSHIPS
INFORMATION VALUE

SET PROBLEM PRIORITIES
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

TRANSLATION OF MAJOR PROBLEMS → APPLICATIONS

CAN OBJECTIVES BE ACHIEVED?
EASIER?
FASTER?
AT LESS COST?
WITH FEWER DIFFERENT PEOPLE?

BY CHANGES IN

ORGANIZATION RESPONSIBILITIES
PROCEDURES
LAYOUT

"QUICK-FIX"/SHORT RANGE PLAN

? EQUIPMENT

AND BY REASSESSING WHAT KIND OF DATA IS BEING COLLECTED?
SHOULD BE COLLECTED?

CAN EDP HELP?
REQUIREMENTS ANALYSIS - STEP 7

REITERATION WITH PROBLEM/SOLUTION FOCUS

- COLLECTION OF MORE DETAILED DATA
  - RELEVANT TO SELECTED PROBLEMS/SOLUTIONS
- SPECIFIC PROBLEM RANKING
  - STRESS IMPORTANT AREAS
- TOWARD EVOLUTIONARY IMPROVEMENTS
EXECUTIVE INFORMATION SYSTEMS    A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

DATA: COLLECTION FLOW ANALYSIS

SIMPLE

REVIEW OF HIST. DATA, TRENDS, REPORTS QUESTIONNAIRES OBSERVATION SAMPLING

TO

I/O MATRICES FLOWCHARTING DECISION TABLES

DATA REDUCTION & SUMMARIES
STATISTICAL TECHNIQUES
MODELLING & SIMULATION

SOPHISTICATED
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

RANKING OF PROBLEM AREAS/APPLICATIONS/CONCEPTS

- Importance in relation to organization/mission
- Urgency in respect to district needs
- Amenability to automation aids
- Ease of introduction
  - Political, economic & skill-constraints
  - Technological "shopping list"
- "Building blocks" for flexible growth
- Relationship to state/other systems

OPS. ENVIRONMENT

FUNCTIONAL ANALYSIS

TO "QUICK-FIXES"

TO SYSTEM DESIGN
EIS ANALYSIS AND DESIGN PROCESS

NEEDS-RECOGNITION-CONTEXT

PLANNING STUDIES
ANALYSIS TECHNIQUES

REQUIREMENTS ANALYSIS

SHORT RANGE PLANS
"QUICK-FIX" PROBLEMS/SOLUTIONS

INFORMATION HANDLING STATE-OF-THE-ART (GENERAL-TO-SPECIFIC CONFIGURING)

"SHOPPING LIST"
EXECUTIVE INFORMATION SYSTEMS
A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

EIS ANALYSIS AND DESIGN PROCESS

NEEDS-RECOGNITION-CONTEXT

PLANNING STUDIES
ANALYSIS TECHNIQUES

OPERATIONAL ENVIRONMENT
ORGANIZATION MISSIONS RESPONSIBILITIES

INFORMATION HANDLING
STATE-OF-THE-ART

TECHNOLOGY (GENERAL-TO-SPECIFIC CONFIGURING)

REQUIREMENTS ANALYSIS

SHORT RANGE PLANS
"QUICK-FIX" PROBLEMS/SOLUTIONS

"SHOPPING LIST"
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ANALYSIS TECHNIQUES

REQUIREMENTS ANALYSIS

OPERATIONAL ENVIRONMENT

FUNCTIONAL ANALYSIS

ORGANIZATION MISSIONS RESPONSIBILITIES

CRITICAL FLOWS PROCEDURES & RULES DATA BASE & ACTIVITY LOADS

TECHNOLOGY (GENERAL-TO-SPECIFIC CONFIGURING)

SHORT RANGE PLANS

"QUICK-FIX" PROBLEMS / SOLUTIONS

"SHOPPING LIST"
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SPECIFICATIONS PROBLEMS / APPLICATIONS CONCEPTS

INFORMATION HANDLING
STATE-OF-THE-ART
TECHNOLOGY (GENERAL-TO-SPECIFIC CONFIGURING)

SHORT RANGE PLANS
"QUICK-FIX" PROBLEMS / SOLUTIONS

"SHOPPING LIST"
## BASIC TYPES OF EFFORT

1. REQUIREMENTS ANALYSIS ✅✅
2. SYSTEM DESIGN & PLANNING ✅
3. DEVELOPMENT, TEST & EVALUATION
4. HARDWARE ACQUISITION
5. OPERATIONAL USE & IMPROVEMENT
EXECUTIVE INFORMATION SYSTEMS | A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

SHOPPING LIST

DESIGN SYNTHESIS

PROBLEMS & APPLICATIONS

OPERATIONAL USE & IMPROVEMENT

HARDWARE

DEVELOPMENT TEST & EVALUATION
SYSTEM DESIGN & PLANNING - STAGE 1

INCREASING NO. OF TECHNOLOGY OPTIONS
(GROWING "SHOPPING LIST")

- HARDWARE
- SOFTWARE
- DATA MANAGEMENT
- OPERATIONAL MODES
- CENTRALIZATION/DECENTRALIZATION

INFINITE NO. OF SYSTEM CONFIGURATIONS
SYSTEM DESIGN & PLANNING - STAGE 1

IMPLICATIONS OF INCREASING OPTIONS

- SYSTEM DESIGN FLEXIBILITY

- ALLOWS DESIGN TO BE LESS "JOB-SENSITIVE"

- CONTROLLING FACTORS
  - LESS: TECHNOLOGY
  - MORE: OPERATIONAL FEASIBILITY
SYSTEM DESIGN & PLANNING - STAGE 1

IMPLICATIONS OF INCREASING OPTIONS

- THEY APPLY TO EVERYONE ELSE TOO
- STATE
- REGIONAL
- SERVICE BUREAUS

- ECONOMIC FACTORS CHANGING RAPIDLY

- FEDERAL ROLE UNCERTAIN
## EIS Options

### History

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**EIS Options**

**Executive Information Systems**

**A Framework for the Evolutionary Development**
SYSTEM DESIGN & PLANNING - STAGE 2

SYSTEM DESIGN/PLAN STRATEGY

- INFORMATION SYSTEM PROBLEMS & GOALS
- NEAR-TERM VS. LONG-RANGE
- FUNDS & SKILLS AVAILABLE
- LOCUS OF INITIATIVE
- IMPACTS OF BIAS
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

STRATEGY

• BUSINESS EFFICIENCY

• EDUCATIONAL EFFECTIVENESS

> RISK, COST, TIME
SYSTEM DESIGN & PLANNING - STAGE 3

DESIGN SYNTHESIS

- SPECIFICATIONS FROM REQUIREMENTS ANALYSIS
- TECHNOLOGY OPTIONS
- STRATEGIC CONSIDERATIONS
- EVALUATION OF ALTERNATIVES
A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

EXECUTIVE INFORMATION SYSTEMS

COMMON DATA BASE

SHOPPING LIST

DATA PROC.
SYSTEM DESIGN & PLANNING - STAGE 4

DESIGN / PLANNING COORDINATION

- DESIGN SYNTHESIS
- COORDINATE PLANS -
  APPLICATIONS DEVELOPMENT
  HARDWARE ACQUISITION
  OPERATIONAL USE & IMPROVEMENT
3. APPLICATIONS DEVELOPMENT

- PACKAGE SIZE
- REGION LABS - STATE - DISTRICT - SCHOOLS
- (PROBLEM AREAS)
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

PLAN 3

PLAN 2

MASTER APPLICATION DEVELOPMENT PLAN

DEVELOPMENT, TEST AND EVALUATION (REGIONAL EXPERIMENTAL LAB SITE)
EXECUTIVE INFORMATION SYSTEMS
A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

4. HARDWARE ACQUISITION

- MAJOR STAGES
- TIME FACTORS
- PEOPLE FACTORS
EXECUTIVE INFORMATION SYSTEMS A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

MAJOR PLANNING MILESTONES

- REQUIREMENT ANALYSIS & DESIGN: 3 - 24 MONTHS
- PROCUREMENT ACTION: 8 - 12 MONTHS
- EQUIPMENT DELIVERY: 1 - 12 MONTHS
- COMPUTER PROGRAMMING: 6 - 12 MONTHS
- SITE PREPARATION: 2 - 18 MONTHS
- PERSONNEL TRAINING: 3 - 12 MONTHS
- INSTALLATION-CONVERSION: 3 - 12 MONTHS

CONTINUING NEED ASSESSMENT

FACTORS AFFECTING

- DEGREE OF CONCURRENCY
- TIME/COST ESTIMATES
  - SCOPE
  - DEGREE OF COORDINATION
  - STABILITY OF REQUIREMENTS
  - QUALITY OF DOCUMENTATION
  - RESOURCES COMMITED
  - ACTUAL TIME AVAILABLE

Pace of Evolution
5. OPERATIONAL USE & IMPROVEMENT

- PHASE-IN OF PLANNED IMPROVEMENTS

- PREPARING FOR FUTURE CHANGE & RENEWAL
"...DOUBTFUL THAT LARGE NUMBER OF SMALL, UNAFFILIATED OPERATORS CAN SURVIVE ... CRITICALLY IMPORTANT TO EXPLORE POSSIBLE ARRANGEMENTS BY WHICH SMALL ORGANIZATION CAN ENJOY SOME BENEFITS OF LARGE-SCALE ORGANIZATION WITHOUT ANY SUBSTANTIAL LOSS OF AUTONOMY"

J.W. GARDNER
SELF-RENEWAL, 1964
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

TOWARD EDUCATIONAL EFFECTIVENESS - FUTURE SYSTEM?

STATE

- OTHER STATES
- REGIONAL LABS
- OTHER DISTRICTS

- Supt. Office
- Staff Areas
- Mgt. Training Areas
- Curriculum Planning & Evaluation Area

- Admin. Office
- Distribution & Control Center
- Teacher Training
- Library/IMC
- Student Counseling
- Student Education Lab.

- Other Schools
- Other Learning Areas - Homes, etc.
EXECUTIVE INFORMATION SYSTEMS

A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

EIS ANALYSIS AND DESIGN PROCESS

SIGN-PLANS

DEVELOP-OPERATE-IMPROVE

OPERATIONAL USE AND EVOLUTION (SPECIFIC SCHOOL DISTRICT AREA)

EVOLVING OPERATIONAL CAPABILITIES

OPERATIONAL CONSTRAINTS & PROBLEMS
NEW REQUIREMENTS

AQUISITION EMPHASIS (MAJOR SYSTEM INCREMENT)

EXPERIMENTAL APPLICATIONS & SPECIFICATIONS

TO ALL DISTRICTS

"SHOPPING LIST"

DESIGN SYNTHESIS

DETAILED DESIGN AND VERIFICATION (REGIONAL EXPERIMENTATION LAB SITE)
EXECUTIVE INFORMATION SYSTEMS | A FRAMEWORK FOR THE EVOLUTIONARY DEVELOPMENT

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MASTER HARDWARE ACQUISITION PLAN

AQUISITION EMPHASIS (MAJOR SYSTEM INCREMENT)

MASTER OPS & SERVICE PLANS

MASTER APPLICATION DEVELOPMENT PLAN

DETAILED DESIGN AND VERIFICATION (REGIONAL EXPERIMENTATION LAB SITE)

"SHOPPING LIST"

DESIGN SYNTHESIS
"WE HAVE MORE INFORMATION & LESS UNDERSTANDING THAN AT ANY TIME IN OUR HISTORY"

ROBERT HUTCHINS

TIME TO THINK ABOUT WHOLE MAN: "THE HUMAN RACE LIVES --- BY ART AND REASONINGS"

ARISTOTLE

INTENSIFY THIS

EIS

ENCOURAGE THIS