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## Environmental Control Systems Life Cycle Cost

### RATIONALE

This document has been determined to contain basic technology which contains useful information concerning ECS cost factors, but newer software programs are available for the actual development for life cycle cost analysis.

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## 1. SCOPE:

This report contains background information on life cycle cost elements and key ECS cost factors. Elements of life cycle costs are defined from initial design phases through operational use. Information on how ECS designs affect overall aircraft cost and information on primary factors affecting ECS costs are discussed. Key steps or efforts for comparing ECS designs on the basis of LCC are outlined. Brief descriptions of two computer programs for estimating LCC of total aircraft programs and their use to estimate ECS LCC, are included.

### 1.1 Purpose:

The purpose of this document is to provide qualitative information on life cycle cost (LCC) aspects of environmental control systems (ECS) design.

## 2. REFERENCES:

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9. Anon.: "Logistics Support Cost Model User's Handbook," U.S. Air Force, August 1976.

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10. Anon: "USAF Cost and Planning Factors," AF Regulation 173-13 Department of the Air Force, February 1982.
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12. Anon: "SAE Aerospace Applied Thermodynamics Manual," ARP1168, Society of Automotive Engineers, Inc.

## 3. BACKGROUND - IMPORTANCE OF ECS LIFE CYCLE COST:

An important part of initial ECS development is to compare alternate ECS designs and the total cost impact of these designs over the life of the aircraft in which it is used (i.e., ECS life cycle cost). In the past, ECS were designed to maximize the thermodynamic performance, with compromises to minimize size, weight and initial cost. Since many ECS costs are fixed by early design choices, it is imperative that implications of ECS design decisions on costs be identified. For example, a 1980 estimate (100 production units) for ECS operational and support costs is 2/3 of ECS life cycle costs, while development and procurement costs comprise the remaining 1/3 (Reference 1). Therefore it is important to determine the impact of ECS design decisions on the operational and support cost part of LCC early in an ECS development program. In order to minimize overall aircraft LCC, it is also important to be aware of and to assess the impact that ECS has on other aircraft systems when evaluating candidate ECS approaches.

## 4. LIFE CYCLE COST CATEGORIES:

Life cycle costs for ECS, and for other aerospace systems and structure, are divided into three categories which occur sequentially, but which generally overlap. These costs may be for "one-time" efforts or hardware (non-recurring costs), or for repetitive efforts or multiple items of hardware (recurring costs). The three life cycle cost categories are: 1) research, development, testing and evaluation; 2) procurement; 3) operations and support. These are outlined in the following sections. More detail about these cost elements is found in References 2 and 3.

### 4.1 Research, Development, Test and Evaluation (RDT&E):

Costs for initial ECS research and feasibility studies, through system development, including prototype and pre-production system testing and test evaluation, are non-recurring. RDT and E cost elements are shown in Figure 1.

### 4.2 Procurement:

Procurement of an ECS in production quantities includes costs which are non-recurring, defined as support investment, and costs which are recurring, defined as system investment.

#### 4.2.1 Support Investment: Support Investment costs are required to implement operational use of the system. Support Investment cost elements are shown in Figure 1.

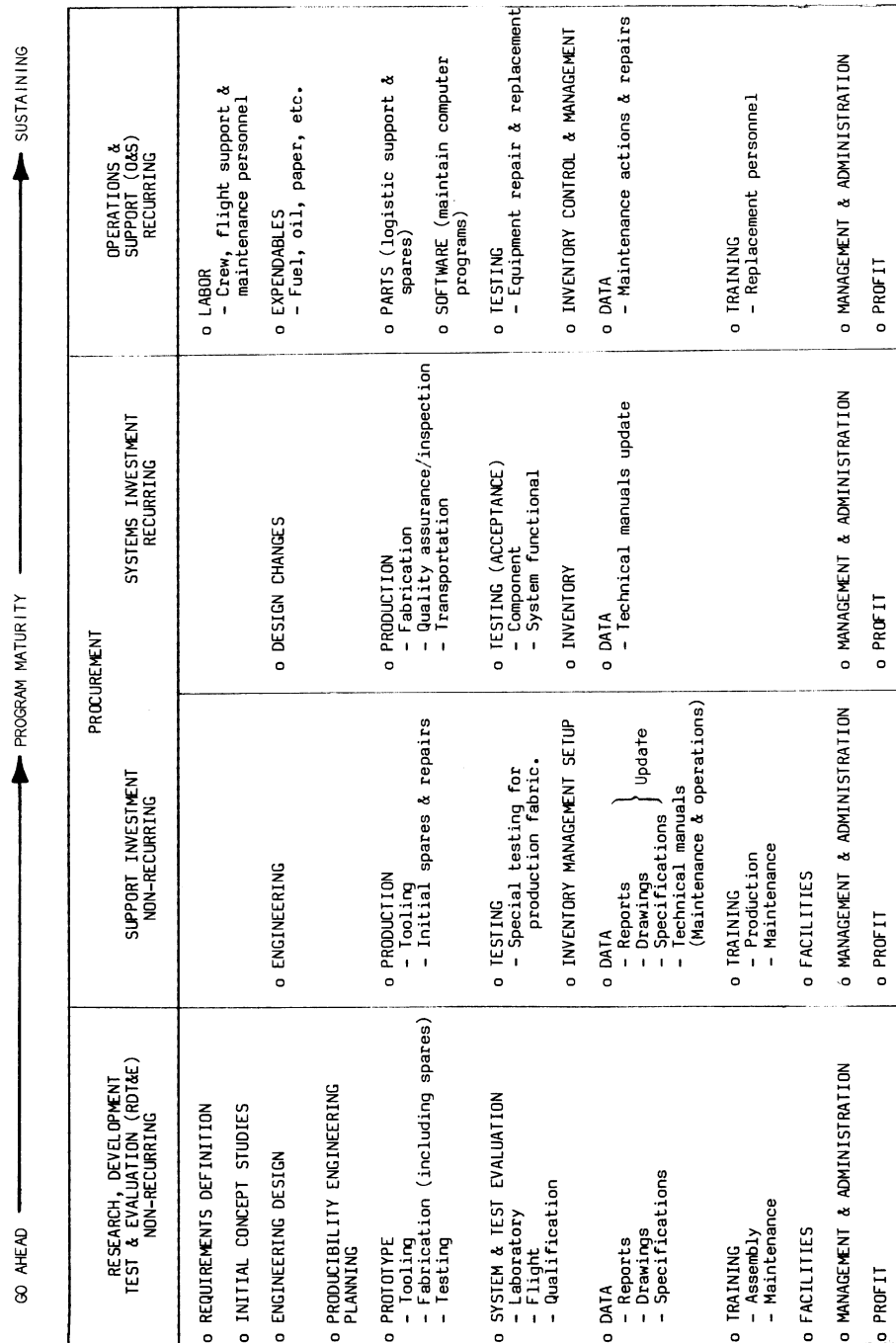


FIGURE 1 - Life Cycle Cost Elements