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Human Interface Design Methodology for Integrated Display Symbology

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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1. SCOPE:

The recommended design approach is described in Figure 1. The approach emphasizes the fundamental relationship between symbols, the information they encode, the context within which the symbols are displayed, and the tasks being supported. While this document is aimed at aircraft displays involving dynamic control or monitoring tasks, the methodology is applicable to a wide range of symbology development situations.

1.1. Purpose:

This document outlines a recommended approach for the design of integrated display symbology in support of flight tasks.

2. APPLICABLE DOCUMENTS:

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP1068	Flight Deck Instrumentation, Display Criteria and Associated Controls for Transport Aircraft
ARP1093	Numerical, Letter and Symbol Dimensions for Aircraft Instrument Displays
ARP4032	Human Engineering Considerations in the Application of Color to Electronic Aircraft Displays
ARP4102	Flight Deck Panels, Controls, and Displays
ARP4107	Aerospace Glossary for Human Factors Engineers

3. DEFINITIONS:

This section contains definitions of terms used in this document

CULTURAL STEREOTYPES: Information interpretations or expectations that are characteristic of a particular culture, discipline, or user community.

DISPLAY MEDIA: The various basic technologies through which information can be communicated visually printed paper, cathode ray tube (CRT) display, liquid crystal display (LCD), etc.

DISPLAY TECHNOLOGY: The technical means by which symbology is presented to an operator.

DYNAMIC INFORMATION: Information which changes during the time of relevant task performance.

HUMAN FACTORS: The study of the physical, mental, and social variables which affect human performance and behavior.

INDIVIDUAL DIFFERENCES: Behavioral or performance characteristics which vary between people even though they have equal qualifications or have received identical training.

INTEGRATION: The combination of two or more functions into a coherent operating entity.

NOTE: Integrated symbology is frequently characterized as having more specific information content than the total number of symbols used. Integrated symbology may also refer to displays containing multiple symbols having a common context.

PERFORMANCE OBJECTIVES: Criteria setting forth the maximum allowable deviations from the relevant dimensions of perfect performance.

REDUNDANT CODING: The use of more than one symbol or symbol characteristic to convey the same information.

STATIC INFORMATION: Information which remains constant during the time of relevant task performance.

SYMBOL: An identifiable display element characterized by shape, size, structure, location, brightness, and color. Any of these characteristics may be static or dynamic. One or more of these characteristics is used to encode information.

SYMBOLOLOGY: The use of one or more symbols which make up a format to portray or define information.

SYMBOL-TASK PAIRING: The relationship between symbol attributes, information content, and the task to be accomplished by the end-user.

3. (Continued):

TRANSFER OF TRAINING: The degree to which learning one skill is facilitated by the prior learning of another task.

NOTE: Negative transfer of training can occur when a previously learned skill interferes with learning of a new skill.

TASK: A physical or mental operation, or a sequence of such operations, performed by a human operator to achieve a specific goal.

TASK ANALYSIS: The process of breaking a task into its component parts, such as skills, actions and decisions.

4. BACKGROUND:

The designer must ensure that display symbols:

- a. Are able to convey, without bias, the specific information they encode.
- b. Are effective, in combination with related symbols, in enabling the user to achieve criterion task performance.
- c. Do not interfere with the interpretation of other flight deck symbols and the performance of other flight deck tasks.

As flight decks become more information intensive and display devices become more flexible, the possibility diminishes of satisfying all three of these requirements at the same time without compromise. Achievement of an effective display is greatly enhanced if the designer uses a structured design approach early in the development cycle.

Consistent use of symbol-task pairings is known to improve transfer-of-training as pilots operate different subsystems in one aircraft or as they make the transition from one aircraft type to another. The increasing sophistication of aircraft flight decks negates much of the one-symbol-one-function simplicity characteristic of earlier aircraft. Highly integrated aircraft and aircraft systems require integrated display symbols. These trends make it more difficult to maintain consistency. The user's finite capacity for recognition, identification, and memory dictates that proliferation of symbols must be carefully managed.

Symbology selection is made more difficult by the fact that modern aircraft flight decks seldom remain in exactly the same configuration throughout their operating life. Changing regulatory, airline, and ATC requirements dictate certain modifications. Improvements in technology and the continuing search for operating advantage and increased efficiency also contribute to the inevitability of flight deck change. For most aircraft many people will be involved in the selection of symbology for use on the flight deck.

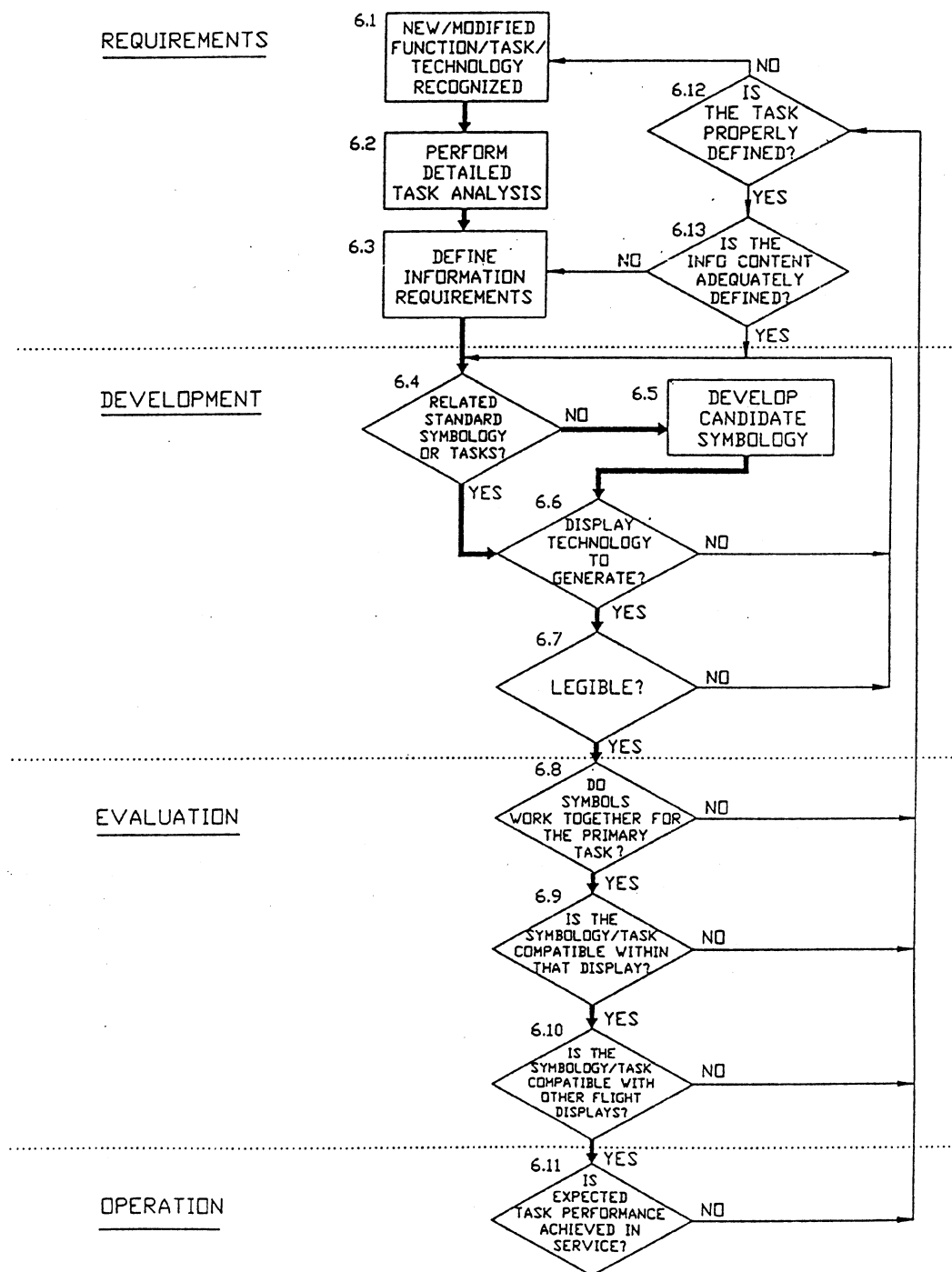


FIGURE 1 - Display Symbology Design Flowchart

4. (Continued):

This document is offered as a first step in expanding the understanding of all who design, integrate, regulate or specify symbology for flight decks and by those who use the symbology. The quality and utility of future versions of this document will benefit from feedback of your comments, insights, and criticisms to the SAE G-10 Committee.

5. DESIGN METHODOLOGY:

The methodological steps shown in Figure 1 are explained in the sections which follow. The recommended approach for achieving the action or decision covered by each step in the process is identified along with one or more reasons why the step is necessary. This is followed by a brief explanation of the key elements involved in completing the step. Any significant cautions or limitations associated with the step are highlighted within a box.

5.1 Recognize a New or Modified Task (Action):

5.1.1 Approach: **The designer should clearly identify the task and related performance objectives the desired symbology is meant to support.**

5.1.2 Reason:

- a. *Identification of quantifiable performance objectives associated with an identifiable task increases the likelihood that the proper task has been recognized.*
- b. *These performance objectives will be the criteria against which the selected symbology will be evaluated.*

5.1.3 The task recognized in this step can result from:

- a. a new user requirement,
- b. the use of technology new to the application,
- c. the transfer of information from one display medium to another,
- d. a change in the means of response available to the user,
- e. the integration of several subordinate or related tasks,
- f. the physical or conceptual integration of two or more existing displays,
- g. a change in the user population, or
- h. the failure of existing symbology to achieve expected performance.

Appropriate task definitions are best developed by beginning from a clearly stated top level system goal, proceeding through identification of applicable constraints on the goal and its achievement, and finally establishing appropriate monitoring requirements for functions assigned to machines or other operators.

While the task likely will be application specific, identification of similarities between this task and other tasks associated with the same user population will aid the effort to achieve consistent symbology usage.