

Systems Design

System-design Procedures

- ❖ Systems orientation requires that desired outcomes are clearly articulated and agreed at the outset of a project.
- ❖ Analytical process proceeds with development of systems specifications and progressive details of equipment, user interfaces, jobs, work modules, tasks, skills and training.
- ❖ Testing and evaluation should be ongoing.

Outcome-goal Preparation

- ❖ Project design objectives are determined through working with clients and users.
- ❖ Quantitative requirement statements for the objectives are developed.
- ❖ Constraints are clearly identified and agreed.
- ❖ Time and development costs are agreed.

Specification development

- ❖ Design alternatives are developed .
- ❖ Design alternatives are evaluated.
- ❖ A design is chosen.
- ❖ Detailed systems design specifications are developed. These can be qualitative e.g. must be comfortable, and quantitative e.g. accident rate must be below 1 in a million.

Subsystem Design

- ❖ Major subsystems that will make up the system are identified.
- ❖ Subsystem development is prioritized.

Mission outline

- ❖ Operational phases required for meeting the terms of the specifications for each subsystem and the overall system are defined.

Functions analysis

- ❖ Mission outline analyzed in terms of operations required to accomplish each operational phase.
- ❖ Functions are statements of work or what must be done in each operational phase.
- ❖ Functional objectives are clearly articulated.

Functions allocation

- ❖ Mission functions are divided and categorized into machine or human components (human operator - HO).
- ❖ Functional fit is evaluated in terms capabilities of machines and HO.
- ❖ Functional allocations can be fixed or flexible (e.g. HO override).
- ❖ Functional allocation continues throughout detailed design.

Activity and Task Analysis

- ❖ Functions allocated to the HO are broken down into subfunctions required to convert 'input' into 'output' (input-output analysis).
- ❖ Subfunctions become task elements. A task is an activity or sequence of activities with a definite start point, end point, and goal.
- ❖ Task complexity is analyzed and compared to human capabilities.
- ❖ Task details are organized into flowcharts (task analysis) and skills identified (skills analysis).

Person-machine interface design

- ❖ Layout of work areas and control-display interfaces defined:
 - ❖ Link analysis - layout is based on frequency of interactions between components.
- ❖ Operational aids and training - instructional materials and HO aids developed. Training programs developed.
- ❖ Environmental requirements and analysis.

Maintenance and Maintainability

- ❖ Maintenance planning
 - ❖ maintenance schedule
 - ❖ fault diagnosis and corrective action
 - ❖ preventative maintenance
 - ❖ parts repair and replacement
 - ❖ upkeep requirements

Design integration

- ❖ Each subsystem tested for suitability
- ❖ Complete operational configuration tested for suitability
- ❖ Systems performance monitored to determine whether output goals are being met.
- ❖ System modifications made as required and system performance is re-evaluated.