Part 1 : System Management.

Ch.2 Logistics System Engineering.

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Definition of System

An aggregation or assemblage of objects united by some form of regular interaction or interdependence: A group of diverse units combined by nature or art as to form an integral whole, and to function, operate, or move in unison and, often, in obedience to some form of control; an organic, or organized whole.
Definition of System.

Characteristics of System.

1. A system constitutes a complex combination of resources in the form of human being, materials, equipment, software, facilities, data, money, and so on.

2. A system is contained within some form of hierarchy.

3. A system may be broken down into subsystems and related components, the extent of which depends on complexity and the function(s) being performed.

4. The system must have a purpose. It must be functional, be able to respond to some identified need, and it should be able to achieve its overall objective in a cost effective manner.
Definition of System.

Different Systems.

▪ Natural and man-made system.

▪ Physical and conceptual systems.
  Physical systems are those made up of real components occupying space. On the other hand, conceptual systems constitute an organization of ideas, a set of specifications and plans a series of abstract concepts, and so on.

▪ Static and dynamic systems.
  Static systems include those having structure, but without activity as viewed in a relatively short period time. A dynamic system is one that combines structural with activity.

▪ Closed and open-loop systems.
  A closed system is one that is relatively self-contained and does not significantly interact with its environment. Conversely, open-loop systems interact with their environment.
Definition of System.

Endogenous vs. Exogenous Variables.

▪ **Endogenous Variables.**
  - A variable whose value is determined by relationships included within the system.
  - The term endogenous is used to describe activities and events occurring within a system.

▪ **Exogenous Variables.**
  - A variable whose values are determined by considerations outside the system.
  - The term exogenous is used to describe activities and events in the environment that affect the system.
Definition and Objectives of System Engineering.

▪ **Definition.**
  The effective application of scientific and engineering needing efforts to transform an operational need into a defined system configuration through the top-down iterative process of requirements analysis, functional analysis, allocation, synthesis, design optimization, test and evaluation.

▪ **Objectives of System Engineering.**
  1. Transformation of an operational need into an integrated system design solution through concurrent consideration of all life-cycle needs.
  2. Ensure the compatibility, interoperability, and integration of all functions and physical interfaces and ensure that system definition and design reflect the requirements of all system elements.
  3. Characterize and manage technical risks.
Characteristics of System Engineering.

- **Top-down Approach.**
  A top-down approach is required, viewing the system as a whole. While engineering activities in the past have very adequately covered the design of various system components, the necessary overview and an understanding of how these components effectively fit together have not always been present.

- **Life-cycle Orientation.**
  A life-cycle orientation is required. Addressing all phases to include system design, and development, production, and/or construction, distribution, operation, sustaining support, and retirement and phase out.
Characteristics of System Engineering.

- **Focus on the initial identification of system requirements.**
  A better and more complete effort is required relative to the initial identification of system requirements. Relating these requirements to specific design goals, the development of appropriate design criteria, and the follow-on analysis effort to ensure the effectiveness of early decisions in the design process.

- **Interdisciplinary or Cross-functional Approach.**
  An interdisciplinary effort (or team approach) is required throughout the system design and development to ensure that all design objectives are met in an effective manner. This necessitates a complete understanding of the many different design disciplines and their interrelationships, particularly for large projects.
Activities in System Engineering.

[Blanchard, System Engineering]

Logistics System Engineering.

Logistics System Life Cycle Phase.

Customer Need Identification.

Needs may stem from several sources, representing a current or anticipated deficiency. The need or mission objective should be described in detail and a time frame for its development established. Outputs of need identification:

- User needs are identified.
- Nature of system is defined.
- Time table for system development established, including project management.
- **Conceptual Design.**

  Conceptual design constitutes the first step in the overall design process and is initiated in response to an identified customer need.

  - Feasibility studies are accomplished.
  - System operational requirements and the maintenance concept are defined.
  - A top-level functional analysis for the system may be completed, the system specification is prepared to describe the design requirements for the system.
- **Preliminary Design.**
  - Identification of alternative system operational functions and sub-functions and maintenance functions.
  - The allocation of requirements from the top-level system to the various subsystems in terms of performance and effectiveness requirements and system supportability.
  - System optimization through evaluation of system alternatives involving reviewing the trade-offs within each system as compared with other systems.
  - System synthesis and definition involving putting together the proposed system in analytical form or in a physical model based on detailed specifications.
Logistics System Life Cycle Phase.

- **Detail Design and Development.**
  - It is referred to as full-scale development. It involves:
    - Detailed descriptions of subsystems and elements, etc., comprising the prime mission equipment and the elements of the logistics support system,
    - Development of an engineering model or prototype that will allow testing and verification of design adequacy.
    - Test and evaluation of mode.
    - Redesign and retest of a system as necessary.
Production and/or Construction.
Materials must flow from the acquisition stage on through to the delivery stage. The production phase involves
- Inventories, material acquisition and control provisions,
- Tooling and test equipment,
- Transportation and handling methods,
- Facilities, personnel and data.
- **Production and/or Construction.**
  The engineering done in the production phase must establish such as:
  - Facilities for production.
  - Manufacturing processes.
  - Inventory requirements.
  - Spare tools for testing, transporting.
  - Work methods, time and cost standards.
  - Evaluation of production operations to assure that the system will perform and be maintained as desired.
• **System Utilization & Retirement.**

The delivery of the prime equipment is accomplished along with software and logistic support to the user. Retirement also occurs at the end of this phase.
**Logistics System Life Cycle Phase.**

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<th>Definition of need</th>
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<td><strong>Conceptual design</strong></td>
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<td>- Feasibility study-alternative technologies</td>
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<td>- System operational requirements (operational functions)</td>
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<td>- System maintenance concept (maintenance functions)</td>
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<td>- Advance system/product planning-system engineering management plan (SEMP), logistics planning</td>
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<td>- System specification</td>
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<th>Preliminary system design (advance development)</th>
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<td><strong>System functional analysis and allocation of requirements</strong></td>
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<td>- System operational functions--(block diagrams)</td>
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<td>- Maintenance functions</td>
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<td>- Allocation of performance and effectiveness factors, design criteria, etc.</td>
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<td>- Allocation of system support requirements</td>
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<td>- Detailed plans and specifications</td>
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<th>System analysis, trade-off studies, and optimization</th>
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<td>- System/subsystem tradeoffs and evaluation of alternatives</td>
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<td>- Development of system support configuration</td>
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<td>- Detailed plans and specifications</td>
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<th>System synthesis and definition</th>
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<td>- Preliminary design--description and structuring of alternative design configurations</td>
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<td>- Development, test, and evaluation of engineering models</td>
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<td>- Design documentation and review</td>
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<td>- Detail design of prime system elements</td>
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<td>- Detail design of system support elements</td>
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<td>- Design analysis and evaluation</td>
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<td>- Design data/review</td>
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<td>- Development of system prototype models</td>
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<td>- Development of system support elements</td>
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<td>- Component test and evaluation</td>
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<th>System prototype test and evaluation</th>
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<td>- System test preparation</td>
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<td>- Testing of system prototype model(s)</td>
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<td>- Test data collection, analysis, evaluation, and corrective action</td>
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<td>- Test reporting</td>
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<th>Production and/or construction</th>
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<tr>
<td>- Manufacture/production/test of prime system elements and system support elements</td>
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<td>- System assessment (data collection, analysis, and evaluation)</td>
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<td>- System modification(s) for corrective action</td>
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<th>System utilization and life-cycle support</th>
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<td>- System assessment</td>
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<td>- System modifications/changes</td>
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Importance of Early Phase.

Cost Effectiveness in System Engineering.

- The greatest impact on life-cycle cost and maintenance/support cost can be during the early phase of design and development.
- In other word, logistics and the design for supportability must be inherent within early system design and development process if the result are to be cost-effective.
Importance of Early Phase.

- Cost Effectiveness in System Engineering.

[Blanchard, System Engineering]
Cost Effectiveness Engineering.

- **The Logistics Support Analysis (LSA)**
  An iterative analytical process by which the logistics support necessary for a new (or modified) system is identified and evaluated.

- **Concurrent/Simultaneous Engineering (CE).**
  A Concept that refers to the participation of all the functional areas of the firm in the system engineering.

- **Software Engineering.**
  - Software that is included as a mission-related component of the system and is required for the operation of that system.
  - Software that is required to accomplish maintenance functions on the system such as diagnostic routines and condition monitoring programs.
  - Software that is required to support program-oriented activities such as the software associated with various computer-based models used for design analysis.
Cost Effectiveness Engineering.

- Design for Reliability, Maintainability. Availability.

- **Design for Human Factors (Ergonomics).**
  A Concept that assure complete compatibility between the system physical and functional design features and the human element in the operation, maintenance, and support of the system.

- **Design for Safety and Security.**

- **Design for Producibility.**
  Producibility is a measure of the relative ease and economy of producing a system or a product.

- **Design for Disposability.**
  Disposability pertains to the degree to which an item can be recycle for some other use or disposed of without causing any degradation to the environment.
- Configuration Management (CM).
  Configuration management (CM) is a management approach used to identify the functional and physical characteristics of an item in the early phase of its life cycle, control changes to those characteristics, and record and report changing processing and implementation status.

- Total Quality Management (TQM).
  A total integrated management approach that addresses system/product quality during all phases of the life cycle and at each level in the overall system hierarchy.
  It provides a before-the fact orientation to quality, and it focuses on system design and development activities.
Performance Check.

1. The purpose of a feasibility study is
   A. To convert a set of customer requirements into a detailed system specification.
   B. To development a set of useful solutions to meet the needs identified in the conceptual design phase.
   C. To validate a configuration of the system for customer requirements.
   D. To develop new directions for future planning.

2. A system is linked together through :

3. Exogenous variables are found :
   A. Inside a system.       B. Inside a subsystem.
   C. Outside a system.       D. To be controllable.
Performance Check.

4. Systems :
A. Once designed considering little or no management.
B. Require management whereby related resources are integrated so that system objectives may be achieved.
C. Mainly focus on the prime operation thing.
D. None of the above.

5. Systems engineering :
I. Is focused on the design of components that go into a system.
II. Usually leads to major breakthroughs in design.
III. Goes forward after assurance that all necessary components will be available.

A. I  B. I, II  C. III  D. None of the above
6. The beginning of a system life-cycle is connected with:
   A. The delivery of the prime equipment.
   B. The development of a prototype.
   C. The identification of a need for a consumer.
   D. The selection of the best system alternative.

7. A preliminary marketing analysis involves:
   A. Customer needs assessment.
   B. Assessment of market potential and market share.
   C. Developing pricing, promoting and distribution strategies.
   D. All of the above,
Performance Check.

8. The result or the output of a feasibility study is:
   A. A preliminary technical proposal.
   B. A go ahead on the final system design.
   C. An assessment of the market potential.
   D. Design Synthesis.

9. The design process involves three design stages:
   A. Preliminary design, detailed design and final design.
   B. Conceptual design, detailed design and final design.
   C. Conceptual design, preliminary design and detailed design.
   D. Conceptual design, preliminary design and final design.
10. Preliminary design is also known as:
   A. Early design.
   B. Second step design.
   C. Conceptual design.
   D. Advance development.

11. Detailed design is sometimes called:
   A. Final design.
   B. Full-scale development.
   C. Third stage design.
   D. Advanced development.
12. Industrial engineering is especially important in:
   I. Need identification stage of the product life-cycle.
   II. Product phase-out.
   III. Production and/or construction stage.
   IV. Product planning.

   A. I.  B. III  C. II, III  D. III, IV

13. Product or system evaluation must be done to:
   A. Assure that the system will perform as it should after it has been delivered.
   B. Assure that the system will perform as it should before it is delivered.
   C. Phase-out an obsolete system.
   D. Meet the requirements of the law.
14. System evaluation and modification task within the product use stage of the system life-cycle
   I. Is also known as the control function.
   II. Is important to the user.
   III. Is important to the vendor.

   A. I   B. II   C. I, II   D. The above of all.
Performance Check.

Solutions.

1  2  3  4  5  6  7  8  9  10  11  12  13  14
B  A  C  B  D  C  D  A  C  D  B  B  B  D