Understanding the Concept of Product Design

NEW PRODUCT DESIGN

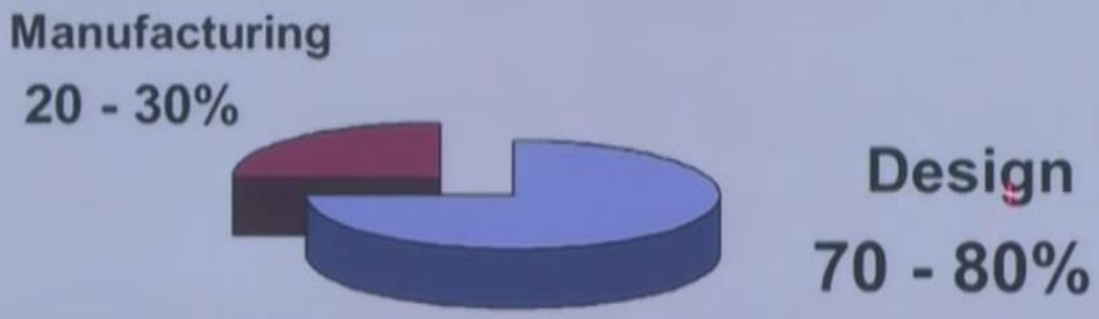
- Every organization has to design ,develop and introduce new product as a survival and growth strategy .
- Product design is conceptualization of an idea about a product and transformation of idea into reality .
- To transform the idea into reality a specification about the product is prepared .

NEW PRODUCT DESIGN

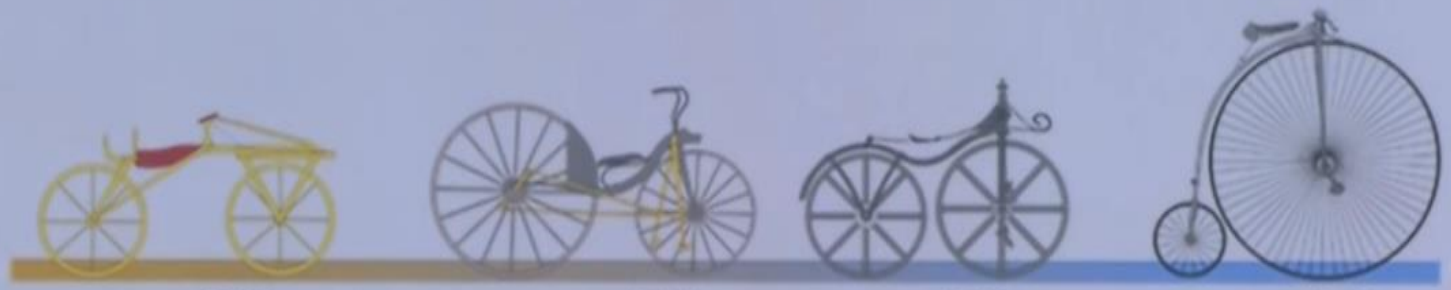
- This specification is prepared by considering different constraints such as production process , customer expectation etc.
- In product design stage, various aspects of the product are analysed
- This decision can be any aspect related to the product e.g. dimensions and tolerances , type of materials for each components.

New Product Design

How the Product Design and Manufacturing Influence the Price, Quality, & Cycle Time?



Product Development



1818
draisine

1869
two-wheel velocipede

1860
pedal-bicycle

1870
high-wheel bicycle

1890
safety bicycle

1960s
racing bike

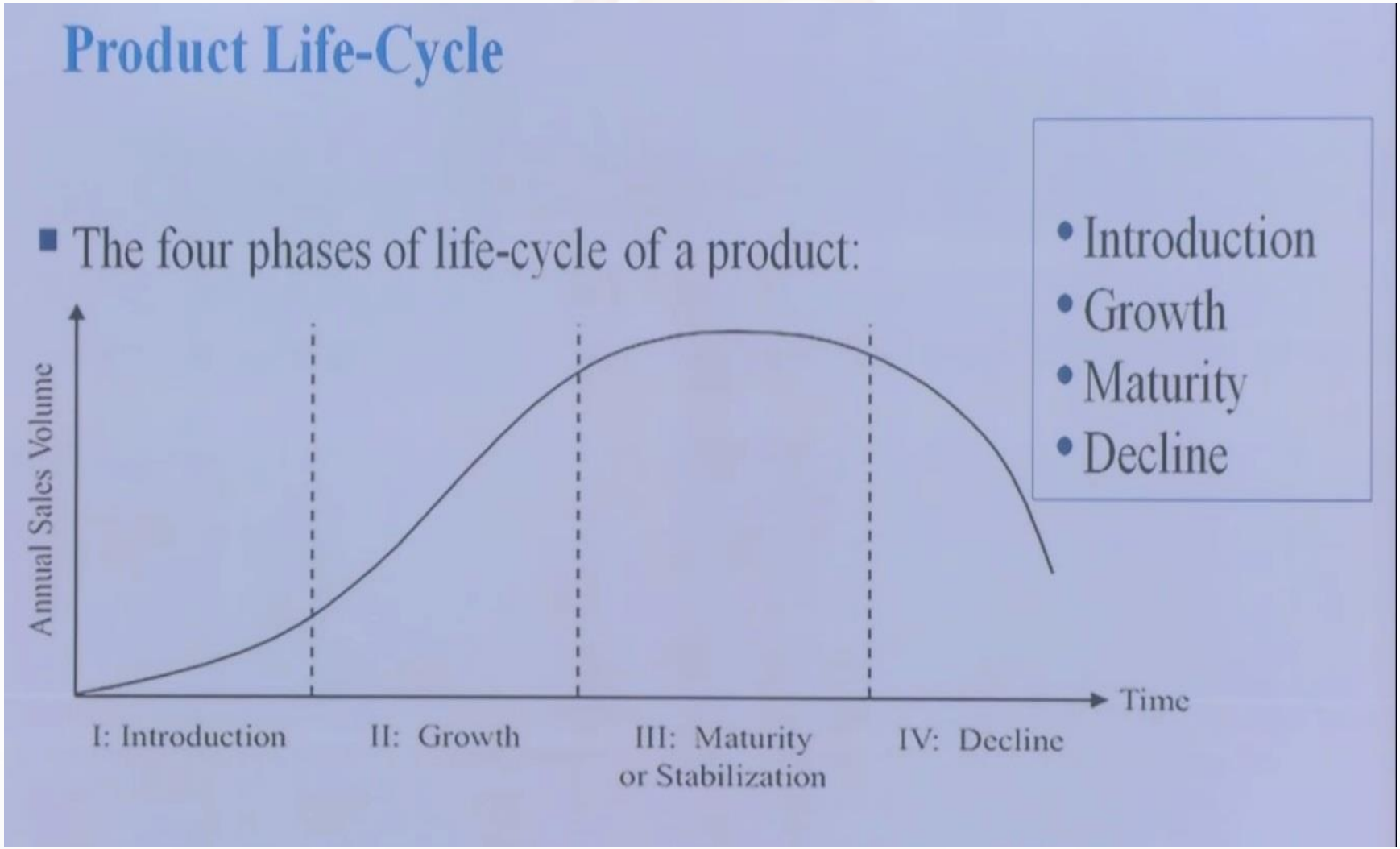
Mid 1970s
mountain bike

NEW PRODUCT DEVELOPMENT STRATEGY

Reasons for new product failure

- Overestimation of market size.
- Poor design
- Incorrect positioning
- Wrong timing
- Priced too high
- Ineffective promotion
- Management influence
- High development costs
- Competition

NEW PRODUCT DEVELOPMENT STRATEGY



Philosophy of Design

- Design by Evolution
- Design by Innovation

Design of Evolution

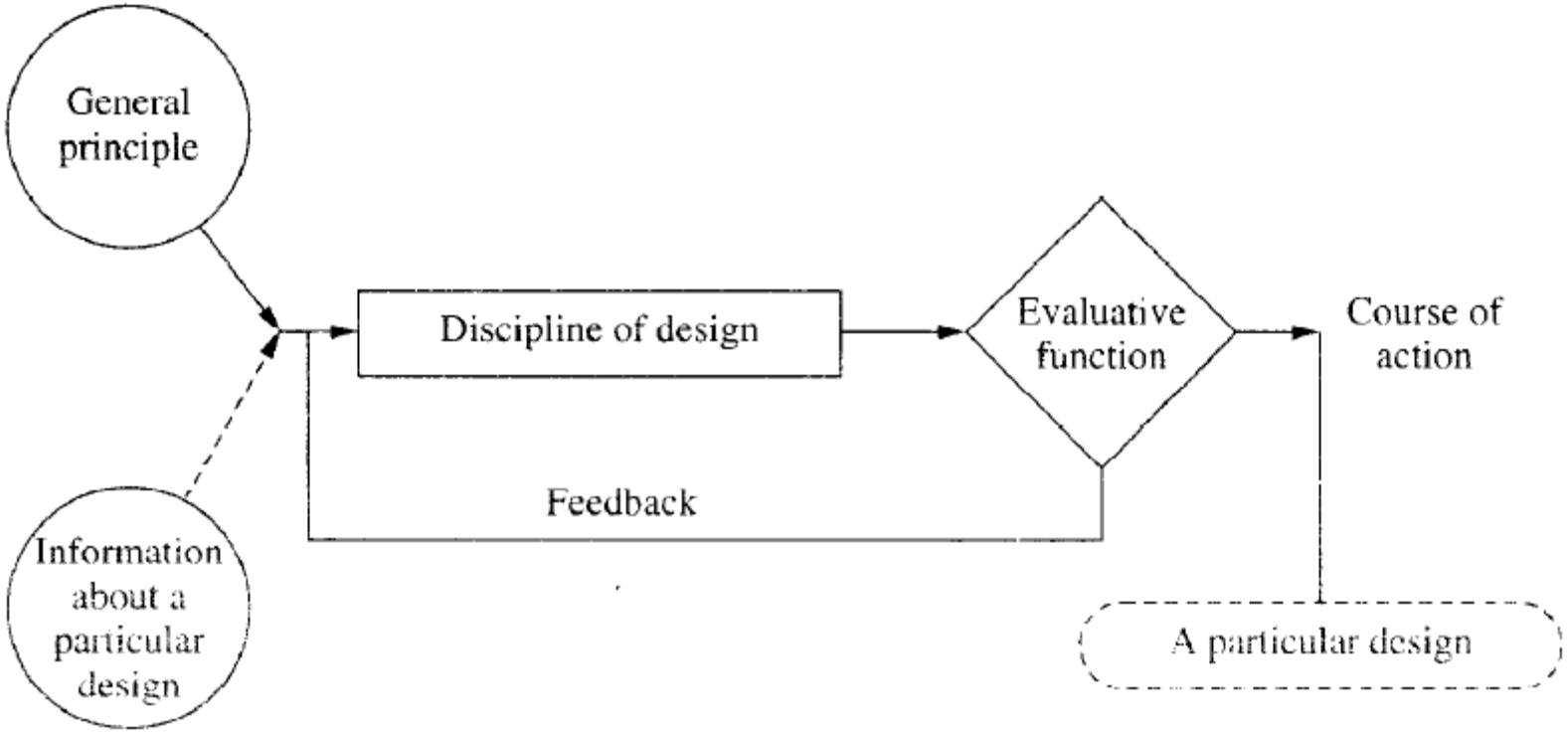
Disadvantages

- Unsuitability for mass production
- Difficulty in modification
- Inability to tap new technologies

Design of Innovation

- Invention of Laser beam
- Invention of solid state electronic devices

Philosophy of Engineering Design



Principles that govern any design

- **Need**:

  Design must be a response to individual or social needs which can be satisfied by the technological factors of culture.

- **Physical Realizability**:

  The object of a design is material good or service which must be physically realizable.

- **Economic Worthwhileness**:

  The good or service, described by a design must have a utility to the consumer that equals or exceeds the sum of the proper costs of making it available.

Principles…

- **Financial Feasibility**:

  The operations of designing, producing and distributing the good must be financially supportable.

- **Optimality**:

  The choice of a design concept must be optimal among the available alternatives, the selection of a manifestation of the chosen design concept must be optimal among.

Principles…

- **Design Criterion**:

  Optimality must be established relative to a design criterion which represents the designer's compromise among possibly conflicting value judgments that include those of the consumer, the producer, the distributor and his own.

- **Morphology**:

  Design is a progression from the abstract to the concrete. (This gives a vertical structure to the design project)

Principles…

- **Design Process**:

  Design is an iterative problem-solving process (This gives a horizontal structure to each design step)

- **Subproblems**:

  In attending to the solution of a design problem, there is uncovered a substratum of subproblems, the solution of the original problem is dependent on the solution of the subproblem.

Principles…

- **Reduction of Uncertainty**:

  Design is a processing of information that results in a transition from uncertainty about the success or failure of a design toward certainty.

- **Economic Worth of Evidence**:

  Information and its processing has a cost which must be balanced by the worth of the evidence bearing on the success or failure of the design.

Principles…

- **Bases for Decision**:

  A design project is terminated whenever confidence in its failure is sufficient to warrant its abandonment, or is continued when confidence in an available design solution is high enough

- **Minimum Commitment**:

In the solution of a design problem at any stage of the process, commitments which will fix future design decisions must not be made beyond what is necessary to execute the immediate solution.

Principles…

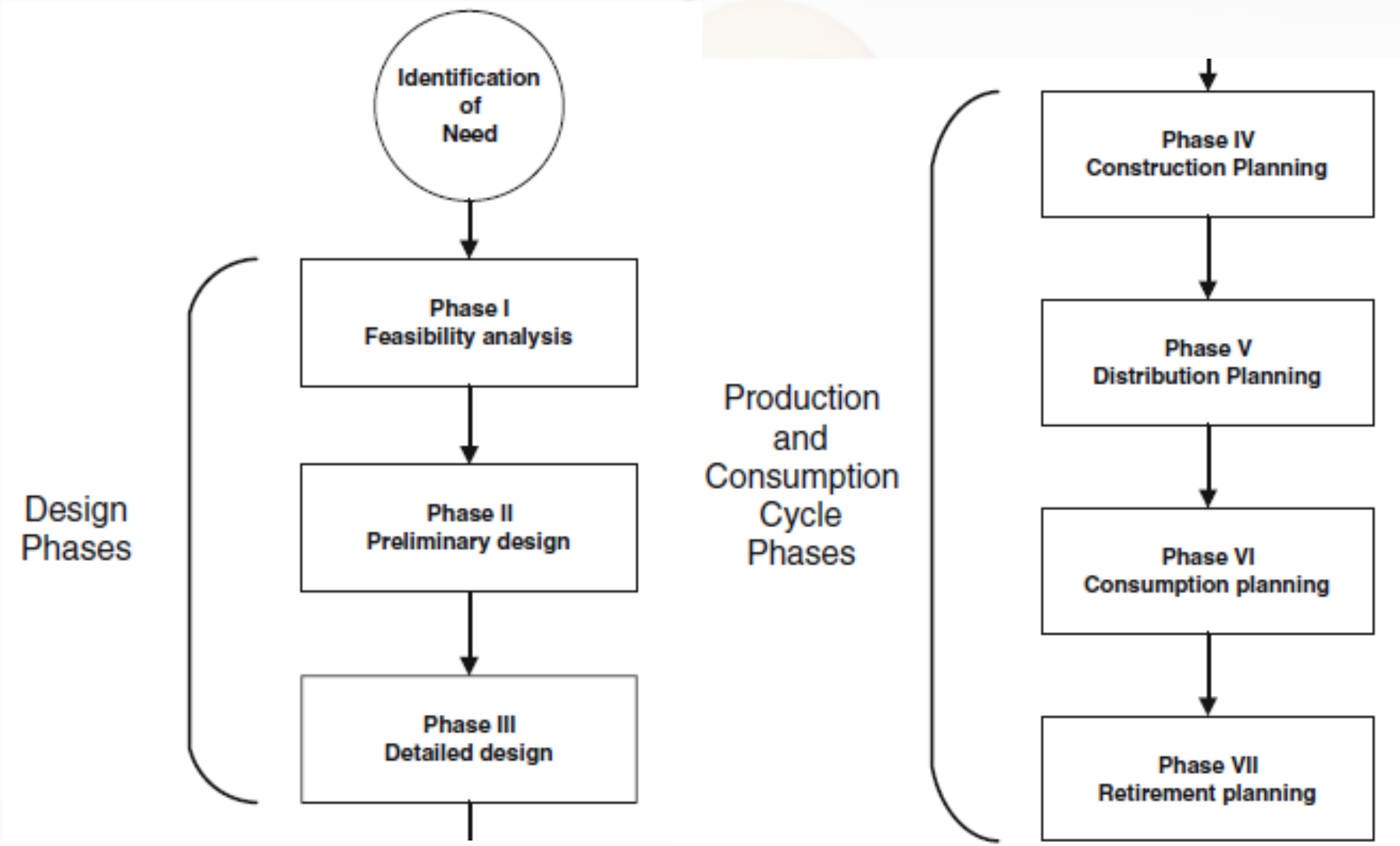
- **Communication**:

  A design is a description of an object and a prescription for its production; therefore it will have existence to the extent that it is expressed in the available modes of communication.

Morphology of Design

- The morphology of design refers to the study of the chronological structure of design projects.
- It is defined by the phases.

Morphology


Identification of Need
Phase I Feasibility analysis
Phase II Preliminary design
Phase III Detailed design
Design Phases
Phase IV Construction Planning
Phase V Distribution Planning
Phase VI Consumption planning
Phase VII Retirement planning
Production and Consumption Cycle Phases

Design Phases

- **Feasibility study**—

  "to achieve a set of useful solutions to the design problem"

- **Preliminary design**—

  "to establish which of the proffered alternatives is the best design concept"

- **Detailed design**—

  "to furnish the engineering description of a tested and producible design"

Phase 1: Feasibility study

- To demonstrate whether the original need does indeed have current existence
- To explore the design problem engendered by the need and to identify its elements such as parameters, constraints, and major design criteria
- To conceive a number of plausible solutions to the problem
- The potentially useful solutions are sorted out of the plausible set in three stepson the bases of physical realizability, economic worthwhileness and financial feasibility.

Feasibility study: Steps and Interconnections

- The need-establishing its economic existence
- The design problem- identification and formulation
- The synthesis of possible solutions
- Physical realizabiity
- Economic worthwhileness
- Financial feasibility

Phase 2: Preliminary design

- Starts with a set of useful solutions
- Purpose is to establish which of the offered alternatives is the best design concept
- Next, projective-type studies are undertaken, addressed to the question of how the solution will fare in time with change in the socio-economic conditions, availability of raw materials, the state of technical art and eventually corrosion, fatigue and deterioration of performance

Preliminary design: Steps and Interconnections

- Step 1: Selection of the design concept
- Step 2: Formulation of mathematical models or archetypes
- Step 3: Sensitivity Analysis
- Step 4: Compatibility Analysis
- Step 5: Stability Analysis
- Step 6: Formal Optimization
- Step 7: Projections into the future

Phase 3: Detailed Design

- Begins with the concept evolved in the preliminary design
- Purpose is to furnish the engineering description of a tested and producible design.

Detailed Design: Steps and Interconnections

- Step1: Preparation for Design
- Step 2: Overall Design of Subsystems
- Step 3: Overall Design of Components
- Step 4: Detailed Design of Parts
- Step 5: Preparation of Assembly Drawings
- Step 6: Experimental Construction
- Step 7: Product Test Program
- Step 8: Analysis and Prediction
- Step 9: Redesign

The Design Process

- Engineering Design is a specialized process of problem solving.
- Although it has its own peculiar way, suited to a technological pattern, its process resembles that of problem solving in general

The general process of solving problems

Stage 1: Diagnose, define, prepare

(An analysis of the situation in which the problem is embedded)

Stage 2: Find a number of alternative solutions

(Synthesis of possible solutions)

Stage 3: Select the best alternative

(Evaluation of the solutions)

Stage 4: Revise

(Revise the solution)

A statement of the Design Process

- The design process describes the gathering, handling and creative organizing of information relevant to the problem situation
- It prescribes the derivation of decisions which are optimized, communicated, and tested or otherwise evaluated.
- It has an iterative character, for often, in the doing, new information becomes available or new insights are gained which require the repetition of earlier operations

A statement of the Design Process…

- The design process resembles the general process of problem solving in the main features, but it uses sharper, and for the most part, more analytical tools, which have been especially shaped and sharpened for the problems of engineering design.
- It carries the process through analysis, synthesis, evaluation and decision, and extends to the realm of optimization, revision and implementation.

The analysis of the problem situation

- Problems rarely come ready made with a fine, clear statement of the factors involved
- Usually it is unclear if there is a single problem or several, and if there are several, what they are
- The designer is presented not with a problem, but with a problem situation, a situation which may have many perplexing elements interrelated in complicated and obscure patterns

The analysis of the problem situation…

- A goal is the end to which a design tends
- In engineering design, the goal must be as specific as we can possibly make them
- The goal must be made explicit so that it becomes a common property of the designer, supervisor and any other concerned
- The random questions must be fitted together in a pattern which constitutes a statement of the problem.

Synthesis of Solutions

- A solution is a synthesis of component elements which hurdles the obstructing difficulties and, neither exceeding the available resources nor encroaching on the limits set by the constraints, accomplishes the prescribed goals.
- There is always more than one solution to a problem, and we seek out as many as we can within the limit of allotted time.

Evaluation and Decision

- Evaluation is the measure of performance, either objective or subjective.
- Having the evaluations, we make the decision of which solution to adopt by taking account of the possibility that any particular solution might turn out unfavourably.

Optimization

- The solution favored by the decision has to be refined.
- But to reach a theoretical level of perfection, optimization is required.

Revision

- In engineering design, every solution must be tested if there is any reasonable doubt about its being satisfactory.
- The tests may reveal flaws that do not, however, discredit the solutions as a whole.
- If so, the solution needs to be revised.
- The process is often iterated, until the flaws have been reduced.

Implementation

- The important solutions must pass beyond the personal spheres.
- They must be implemented and communicated.

Referecnes

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Thank you