BASICS OF PROBLEM DEFINITION

Characteristics of Problems

- Engineers are problem solvers.

- Problems are problems only when we are aware of them.
  
  Crisis ---> Solution

- Problems are often confused with solutions -- leads to advocacy and early commitment, ownership, actions to save face.

- Don't accept the original problem statement -- a person may believe that a demon causes his leg to hurt – this is a symptom of the problem – perhaps it is actually a broken leg.

- Problems are problems because they have no easy answers – if they did, they would be already solved.

- Solutions often become problems -- i.e. the automobile.

- Problems and values change over time. What was a good solution once doesn't work any more.

- Problems are total; solutions, disciplines seldom are.

- A problem is a problem if you believe it to be one.

- Anticipate and broaden your view of the problem.

- What are the relevant factors??
  
  - Usually very many
    - Technical
    - Social
    - Economic
Components of Problem Definition

Describe System:

- What is the function of the system?
- Size of things -- constraints? Dimensions, weight.
- Environment -- weather, temperature, moisture.
- Skills, ability.
- People -- what particular types?
- Systems -- higher and lower level system goals, interfaces
- Flows -- how do pieces fit together, what activities are there and how are they related?
- Components -- what are the parts and what is their purpose?

Goals:

- What are critical factors, characteristics of an ideal system?
- What is the goal of your design?
- How do you measure performance of the system?
- What is wrong with the current system? In relation to your goals?
- Economics -- costs, value, prices, cash flow

Environment:

- The Market -- who uses it, what are their characteristics?
- The Competition -- what systems currently exist? Good points? Bad points?
- "Need to Know" list -- what do you have to know to work on the problem?
- Weather -- cold, warm, rain, dry, humid
- People -- size, strength, skills, literacy, handicaps, sight, hearing.
- Materials -- strength, transport, soils, sources, durability, workability.

- Emergencies -- fire, flood, wind, safety, security, crime.

- Procedures -- construction process, labor relations, management, payments, schedules, sequences.
Good

Higher Order System

variables

PROBLEM ↔ System

Inputs

Relationships

Problem Environment

Constraints

Lower Order System

Parameter

Criteria

Good

Bad

(symptoms)

Outputs

Problem Boundaries

Parameter

Criteria

Good

Bad

(symptoms)
Problem Solving Methods

There are three basic methods to solve problems

1) The Good Idea Approach. You are somehow inspired and have a "good idea" which you attempt to develop and defend against all criticism. This approach often leads to failure since there is usually a closed mind to other ideas. Bad news is ignored until it is too late.

2) The Scientific Method. Begin by stating a theory or hypothesis. Collect data and analyze it to determine if the theory/hypothesis is true or false. Not really a relevant method for design problems since it involves the search for truth rather than the search for an answer.


Don't define problems as solutions; i.e. build a better mousetrap.
Don’t reject alternatives prematurely.
Don’t evaluate until problem and alternatives are clearly defined.
The Systems Approach – Expanded Version

Project Planning

Problem Definition

- Identify higher order goals, functions, outputs and needs
- Identify system level goals, functions, outputs and needs

Function

- Develop a large list of alternatives
- Develop feasible set of alternatives

Model (predict performance)

- Develop measures of effectiveness

Determine effectiveness of each alternative

Determine importance of goals

Evaluation

Cost model

- Develop cost of each alternative

Interpretation

Uncertainty
Contingencies
Sensitivity
Omitted

Action?

Iterate

No