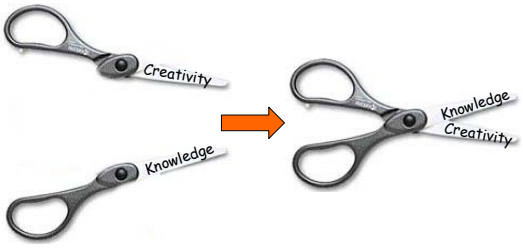
Problem Solving

- **Knowledge** is necessary to understand and the problem and develop technically feasible solution

- **Creativity** is necessary to generate new and innovative ideas

Problem Solving

- However, analogous to a pair so scissors, no cutting (problem solving) can be done with only one shear.



Problem Solving

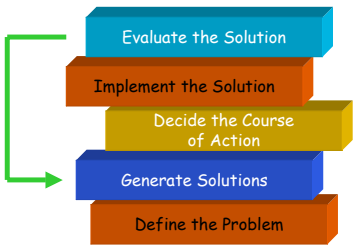
- **Creativity** alone will not generate solutions that are necessary technically feasible
- **Creativity** along with knowledge allows us to ***cut*** through the problem and obtain original solutions

The *Real* and the *Perceived* Problem

- Engineers must learn to define the ***real*** problem as opposed to the ***perceived*** problem
- Developing and applying a problem-solving heuristic will help define the ***real*** problem more rapidly
- *A problem solving heuristic is a systemic approach to problem solving that helps us through the solution process and generate alternative solution pathways*

The *Real* and the *Perceived* Problem

- A problem solving heuristic:



The *Real* Problem

- Defining the ***real*** problem can be a very difficult task
- Sometime we are "tricked" into treating the symptoms instead of solving the problem - (*putting a bucket under a leaking roof*)
- Finding the ***real*** problem (*the cause of the leak*) is important

What's the Real Problem?

- The case of the hungry grizzly bear - or - an exercise in defining the "real problem"

Examples of Ill-Defined Problems

- ***The Situation:*** Shortly after the upper floors of a high rise hotel had been renovated to increase the hotel's room capacity, the guests complained that the elevators were too slow. The building manager assembled his assistants.

- **His instructions to solve the perceived problem**: "Find a way to speed up the elevators."

- After calling the elevator company and an independent expert on elevators, it was determined that nothing could be done to speed up the elevators

Examples of Ill-Defined Problems

- **The manager's directions were**: "Find a location and design a shaft to install another elevator."
- An architectural firm was hired to carry out this request. However, neither the shaft nor the new elevator were installed because shortly after the firm was hired the real problem was uncovered

Examples of Ill-Defined Problems

- *The real problem was to find a way to take the guests' minds off their wait rather than to install more elevators. The guests stopped complaining when mirrors were installed on each floor in front of the elevators*

Emirates General Petroleum Corporation, Dubai, U.A.E.

Leaking Flowmeter

- ***The Situation:*** Flowmeters, such as the ones at the gasoline pumps to measure the number of gallons of gas delivered to your gas tank, are commonplace in industry. A flowmeter was installed in a chemical plant to measure the flow rate of a corrosive fluid. A few months after installation, the corrosive fluid had eaten through the flowmeter and began to leak onto the plant floor.
- **The perceived problem:** "Find material from which to make a flowmeter that will not corrode and cause leakage of the dangerous fluid."

Leaking Flowmeter

- An extensive, time-consuming search was carried out to find such a material and a company that would construct a cost effective flowmeter. None was found.
- *The real problem was to prevent the flowmeter from leaking. The solution was to institute a program of simply replacing the existing flowmeter on a regular basis before corrosion caused a failure*

Right Problem/Wrong Solution

- In this case the *real* problem has been correctly identified, however, the solution is inadequate

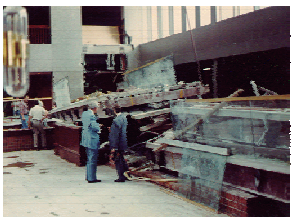
The Kansas City Hyatt

- The Kansas City Hyatt The newly constructed Kansas City Hyatt Regency Hotel opened in 1980. It had three skywalks connecting the bedroom areas with the conference areas on all three levels. The skywalks were 120 feet long and were suspended from the roof.

Right Problem/Wrong Solution

- On July 17, 1981, a tea dance was being held in the lobby area, and people were watching from the skywalks and from the lobby below. The lower two skywalks collapsed, plummeting to the lobby below. Over 70 tens of concrete and girders fell to the ground. There were 114 people killed and hundreds more injured.

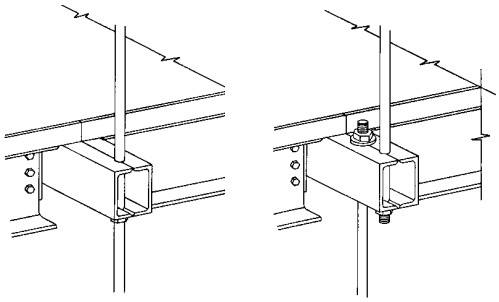
Right Problem/Wrong Solution



Right Problem/Wrong Solution

- But somewhere between the original design and the actual construction, it was decided to replace each single long rod by two shorter rods.
- As a result, the bolt under the top walkway had to support not only the upper walkway, but the lower one as well, which doubled the force on the upper bolt.

Right Problem/Wrong Solution

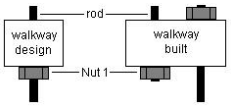


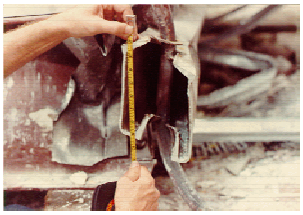
Initial Design Final Design

Right Problem/Wrong Solution

- It did not take long to determine the cause of the accident.
- In the original design the top walkway was to be hung from the ceiling by long rods that passed through it and also supported the lower walkway.
- In this version of the design, each bolt had to support only one walkway.

Right Problem/Wrong Solution





Problem Solving

End of Chapter 1