Getting the right requirements right

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Topics

- The undesirable situation

- The requirements discovery process

- The two requirements paradigms

- Why the 'B' paradigm is
  - The most popular
  - Inherently flawed

- Getting the right requirements right

The undesirable situation

- Requirements elicitation and elucidation are a critical part of the so-called "systems engineering process"
- The characteristics of good requirements have been known and taught since at least 1992
  - [Hooks, 1993]
- There are no metrics for the quality of requirements
- Commercial requirements tools are dumb
- Poor requirements continue to be a major cause of project failure

The requirements discovery process*

The Requirements Discovery Process

* Bahill and Dean, 1997
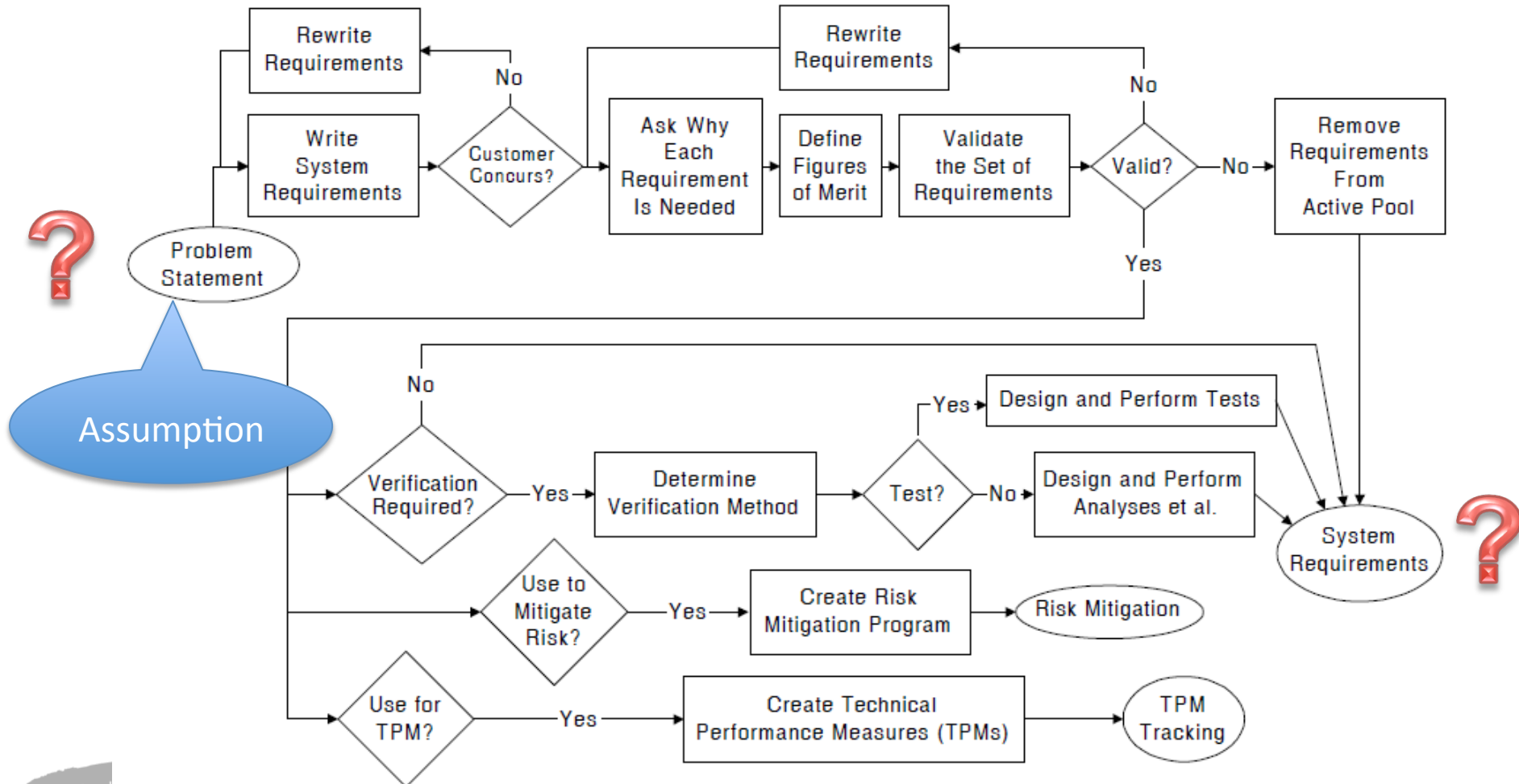
Overly complicated

Complicated example in
Rube Goldberg cartoon

Requirements

Layer of Systems Engineering / Phase in the Life Cycle		Needs identification	Requirements	Design	Construction	Unit testing	Integration & testing	O&M, upgrading	Disposal
Socio-economic	5								
Supply Chain	4								
Business	3								
System	2								
Product	1								
		A	B	C	D	E	F	G	H

Produced here → ← Used here →

Requirements drive the work

Requirements

Manuals

Design plans & documents

Test Plans

Test Procedures

Designs → **Tests** → **Reports**

Requirements

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Produced here   What happens here ?   Used here

Concept of operations (CONOPS)*

- Normal and contingency mission functions
- Normal and contingency support functions
- From start to finish of the mission
  - Scenarios or 'use cases'
  - Clear vision of what future solution system will do
  - "to-be" system
    - Business Process Reengineering
  - Facilitates complete and correct "requirements"

* Kasser and Hitchins, 2011

The CONOPS drives the work

CONOPS

Requirements

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Test Plans

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Designs → **Tests** → **Reports**
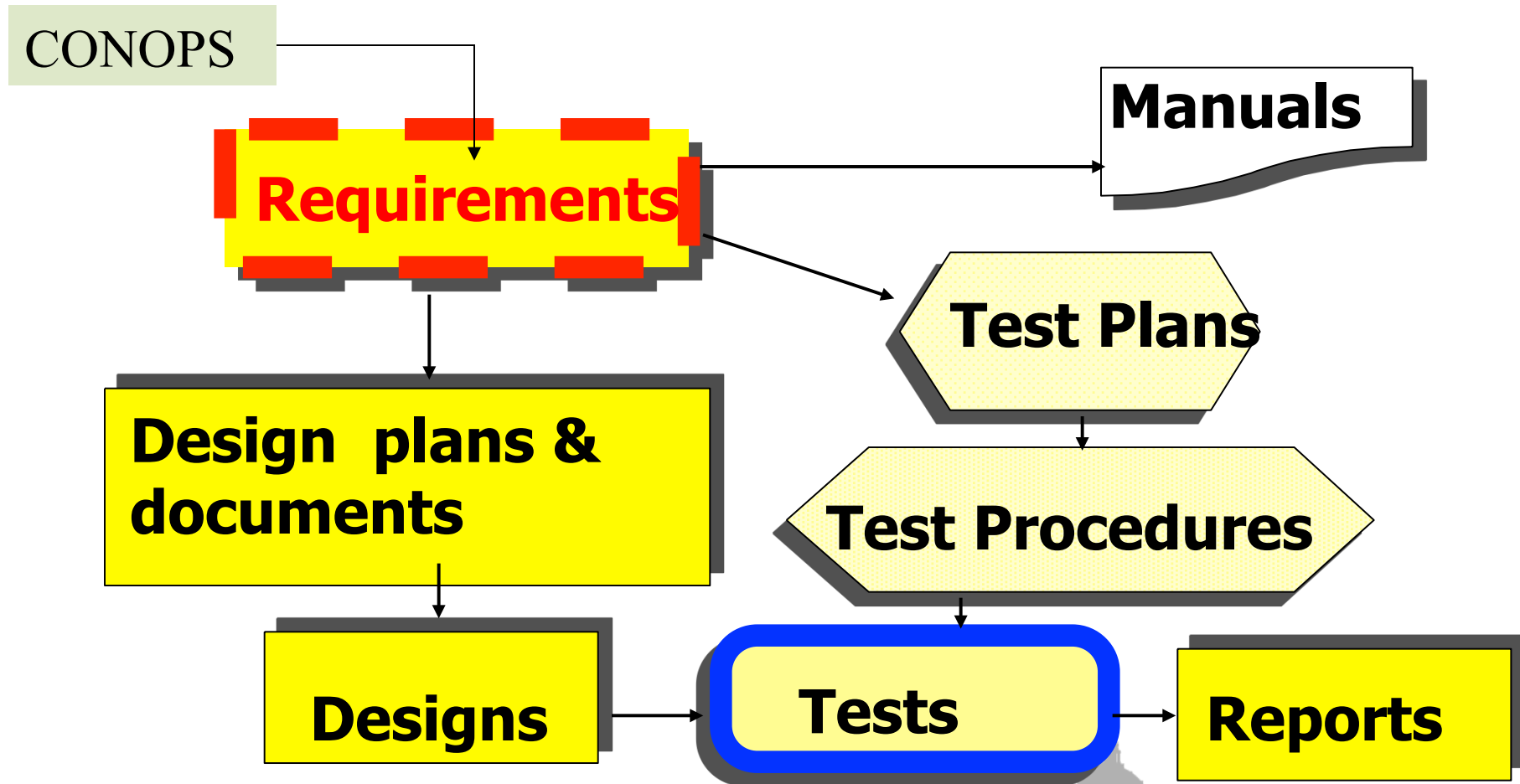
Two requirements paradigms

- The "A" Paradigm
  - CONOPS
  - Original systems engineering of the 60's
  - Successful projects characterized by common vision of future desirable situation
  - Create/architect a process to realize the solution
    - Biemer and Sage, 2009, page 153, Kasser and Palmer, 2005
      - The SEMP

- The "B" paradigm
  - Requirements are one of the inputs to the 'systems engineering process'
  - Taught in most systems engineering courses
    - (Martin, 1997) page 95), (Eisner, 1997) page 9), (Wasson, 2006) page 60) and (DOD 5000.2-R, 2002), pages 83-84)
  - Follow the process
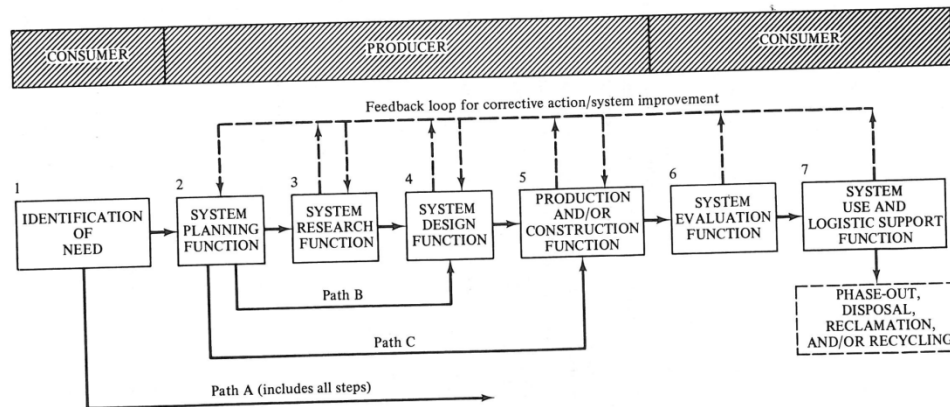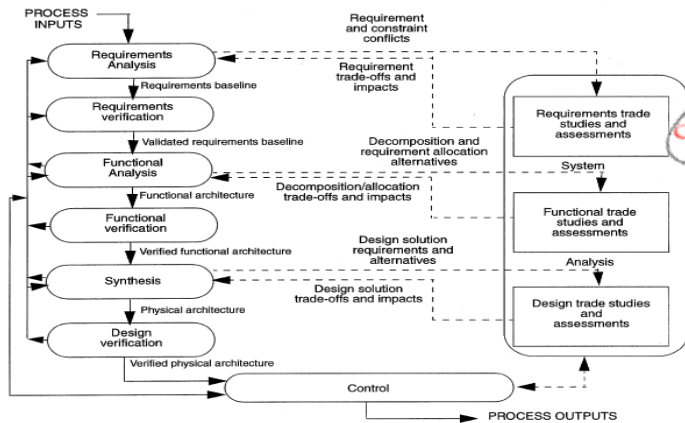
Which process?
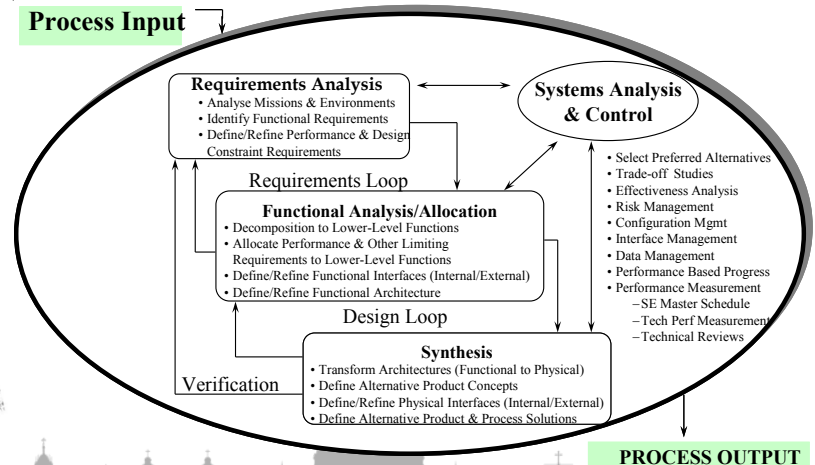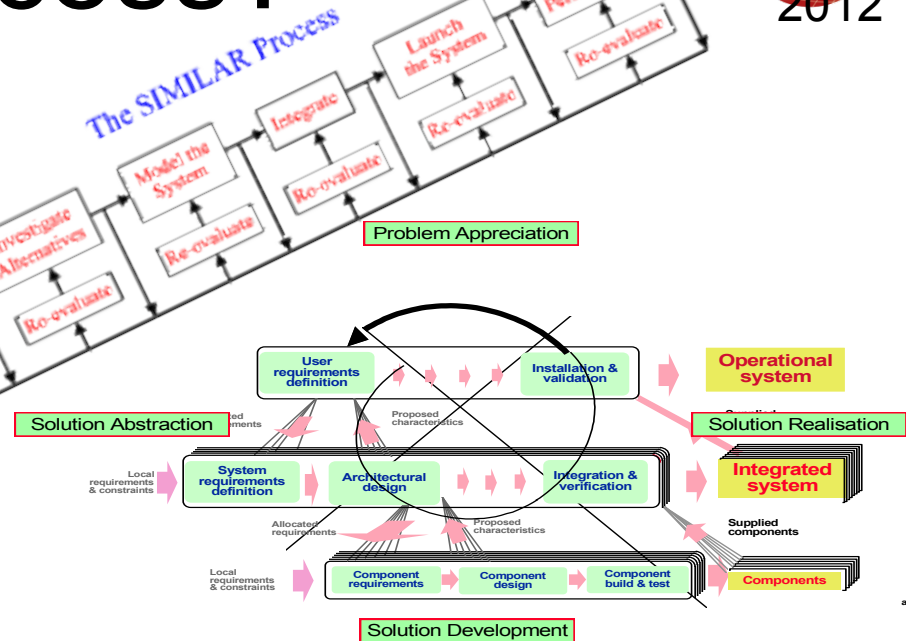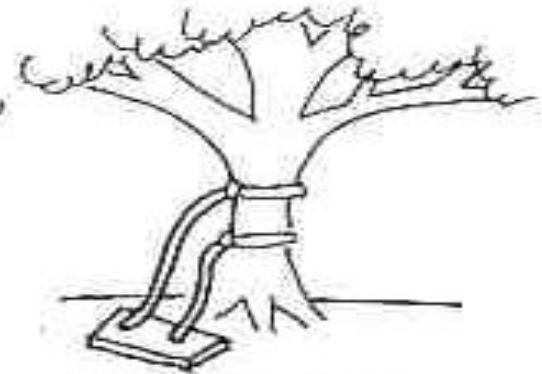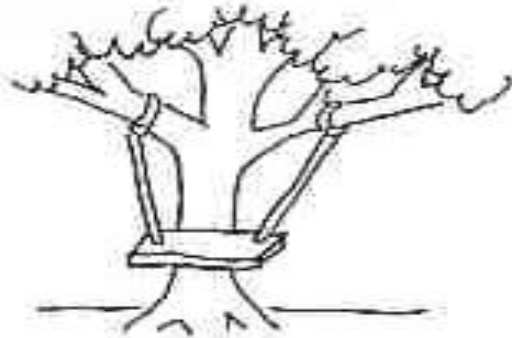
The systems engineering process (1970)
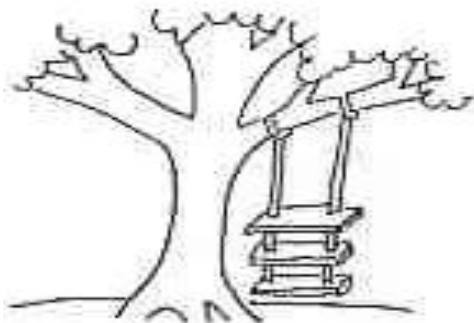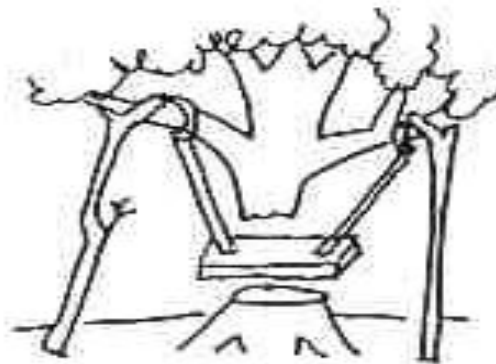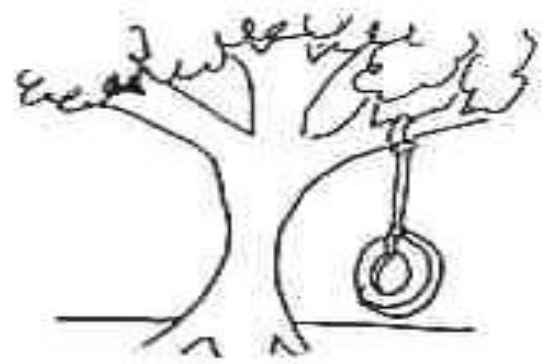

WHAT THE RFP DESCRIBED
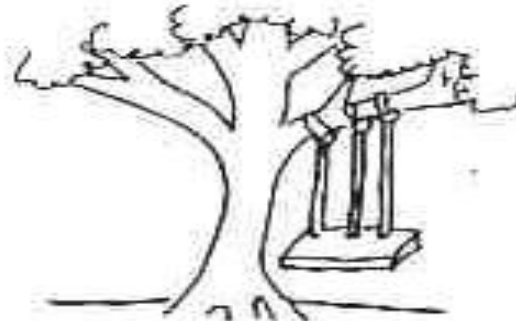
HOW THE BIDDER UNDERSTOOD IT

WHAT WAS SPECIFIED

WHAT WAS DESIGNED

WHAT WAS IMPLEMENTED

WHAT THE CUSTOMER REALLY WANTED

The systems engineering process (2010)

More steps

How the customer explained it
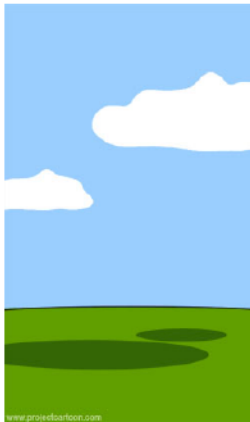
How the project leader understood it
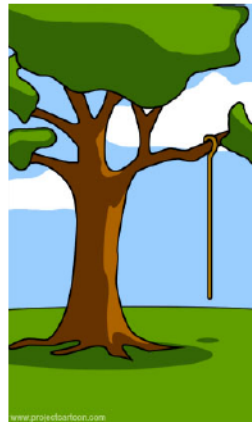
How the analyst designed it
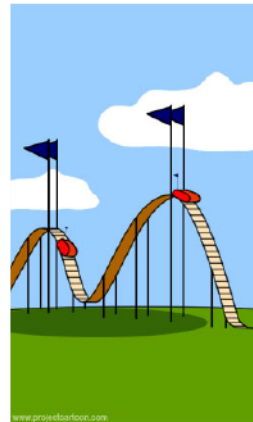
How the programmer wrote it

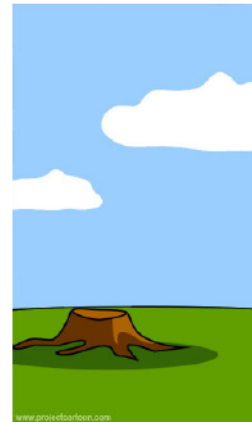How the business consultant described it

How the project was documented
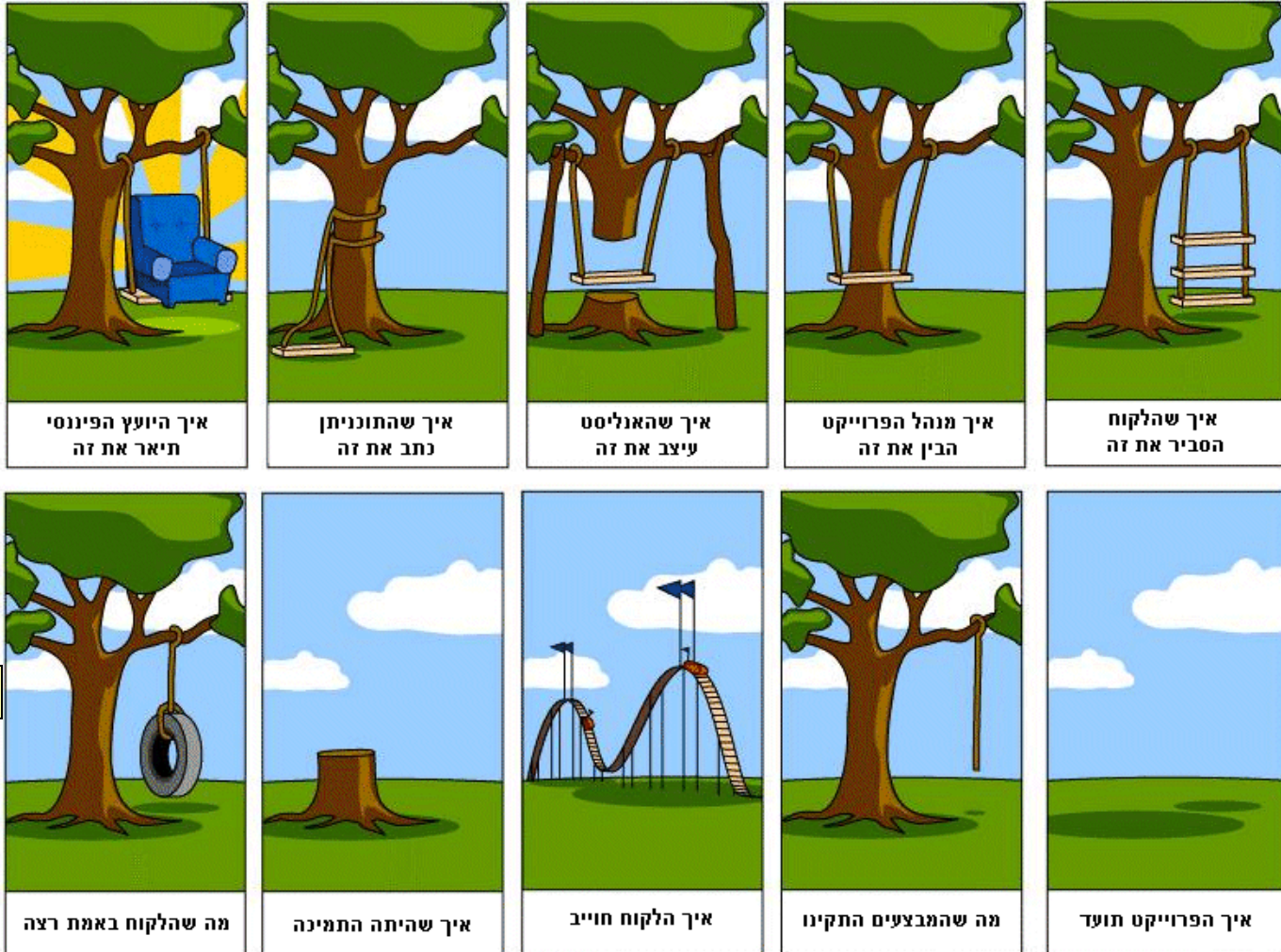
What operations installed

How the customer was billed

How it was supported

What the customer really needed

International problem

Start

End

15

The "B" paradigm is inherently flawed

- Cannot determine if the requirements and associated information are correct and complete
  - No reference for comparison to test the completeness
  - Efforts expended on producing better (well-written) requirements **have not, and will not**, alleviate the situation
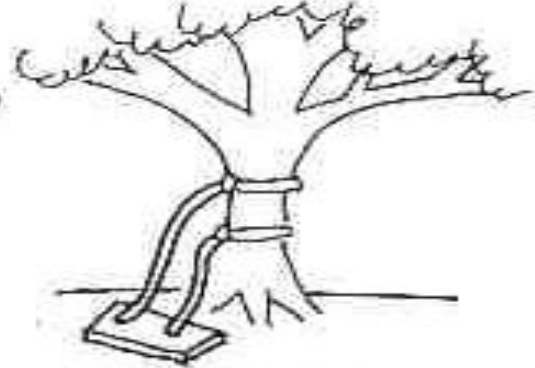- Deming's red bead experiment situation

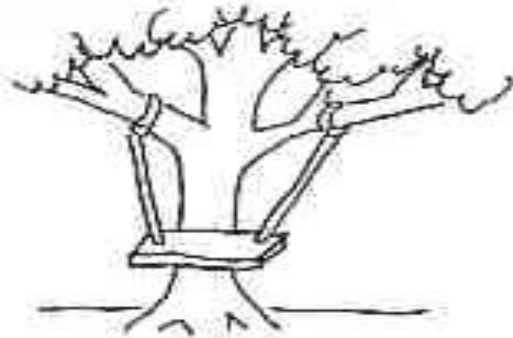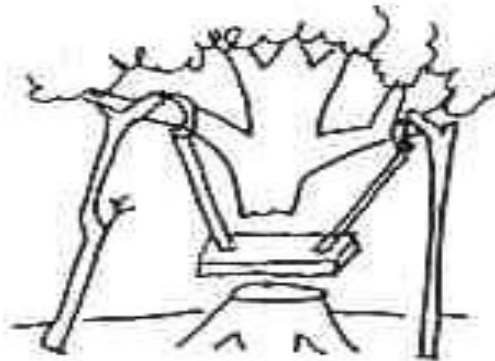# The systems engineering process (1970)
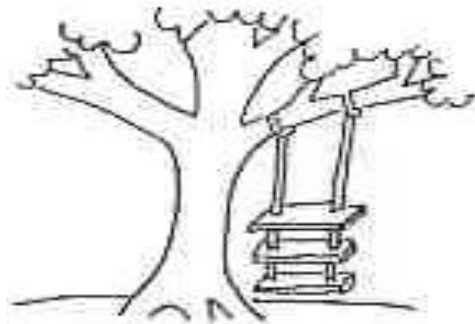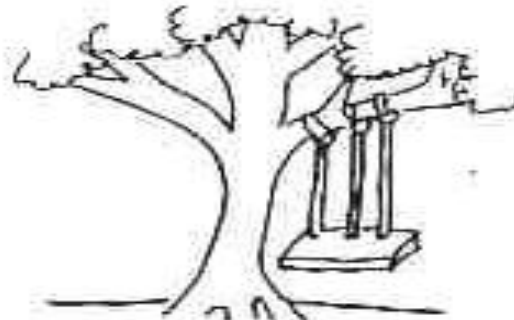
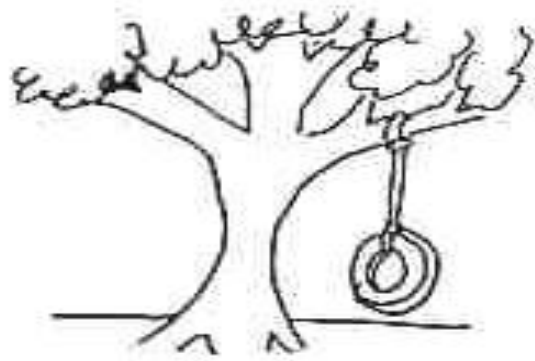WHAT THE RFP DESCRIBED

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Lack of a common vision of the solution

Recognition that the "B" requirements paradigm is inherently flawed

- Sutcliffe, et al. (1999) proposed reducing human error in producing requirements by analysing requirements
  - using an approach of **_creating scenarios as threads of behaviour through a use case_**, and adopting an object-oriented approach;
- Daniels et al. (2005) point out that standalone requirements make it difficult for people to understand the context and dependencies among the requirements,
  - especially for large systems and **suggest using use cases to define scenarios**
- One of the two underlying concepts of Model Based Systems Engineering (MBSE) is
  - **to develop a model** of the system to allow various stakeholders to gain a better understanding of how well the conceptual system being modelled could remedy the problem,
  - **before starting to write the requirements**.

Getting the right requirements right

- In the 21st century a model or better still, an Object-Oriented CONOPS (OOCONOPS)[*] can represent the user's needs in a manner verifiable by all stakeholders

  – There is no need for writing many of the requirements that seem to be needed in the "B" paradigm

* Read about the OCH and benefits of an OOCONOPS in the paper

Benefits of "A" paradigm
What is a good requirement?

- **Product dimension**
  - Describes something ("what") about the system to be realized

- **Process dimension**
  - Facilitates the process of implementing the system

- **It's a real requirement**
  - Well-written but useless

The real requirement

Acceptance

People don't always state the real requirement/need

Example

103. Except on Saturdays, the system shall transport up to 1000 men with up to 100 Kilograms of baggage each, up to 1000 miles, within 10 hours.

Is this a well-written requirement? Is anything missing?

Example-2

This is why you need a CONOPS

Requirements

103. The system shall operate six days a week, Sunday to Friday[1].

104. The system shall transport up to 1,000 men each weighing no more than w Kilograms[2].

105. The system shall transport up to 100,000 Kilograms of baggage.

106. The system shall transport men and baggage up to 1600 Kilometers[3].

107. The system shall complete the transport within 10 hours[4].

108. The volume of an individual item of baggage shall not exceed n by m Meters.

Questions

[1] How many hours per day?

[2] Should we use minimum, average or maximum weights for the people?

[3] What state should the men and baggage be after transportation?

[4] Is the 10 hours included in 103?

[5] …

Summary

- The undesirable situation

- The requirements discovery process

- The two requirements paradigms

- Why the "B" paradigm is
  - The most popular
  - Inherently flawed

- Getting the right requirements right
  - Go back to the "A" paradigm

Questions and comments?