

# Requirements Analysis, *Modeling* and Specification

- ☐ Requirements Analysis, Modeling and Specification
- ☐ Problem
- ☐ Carving the Solution Space
- ☐ Prioritizing Requirements

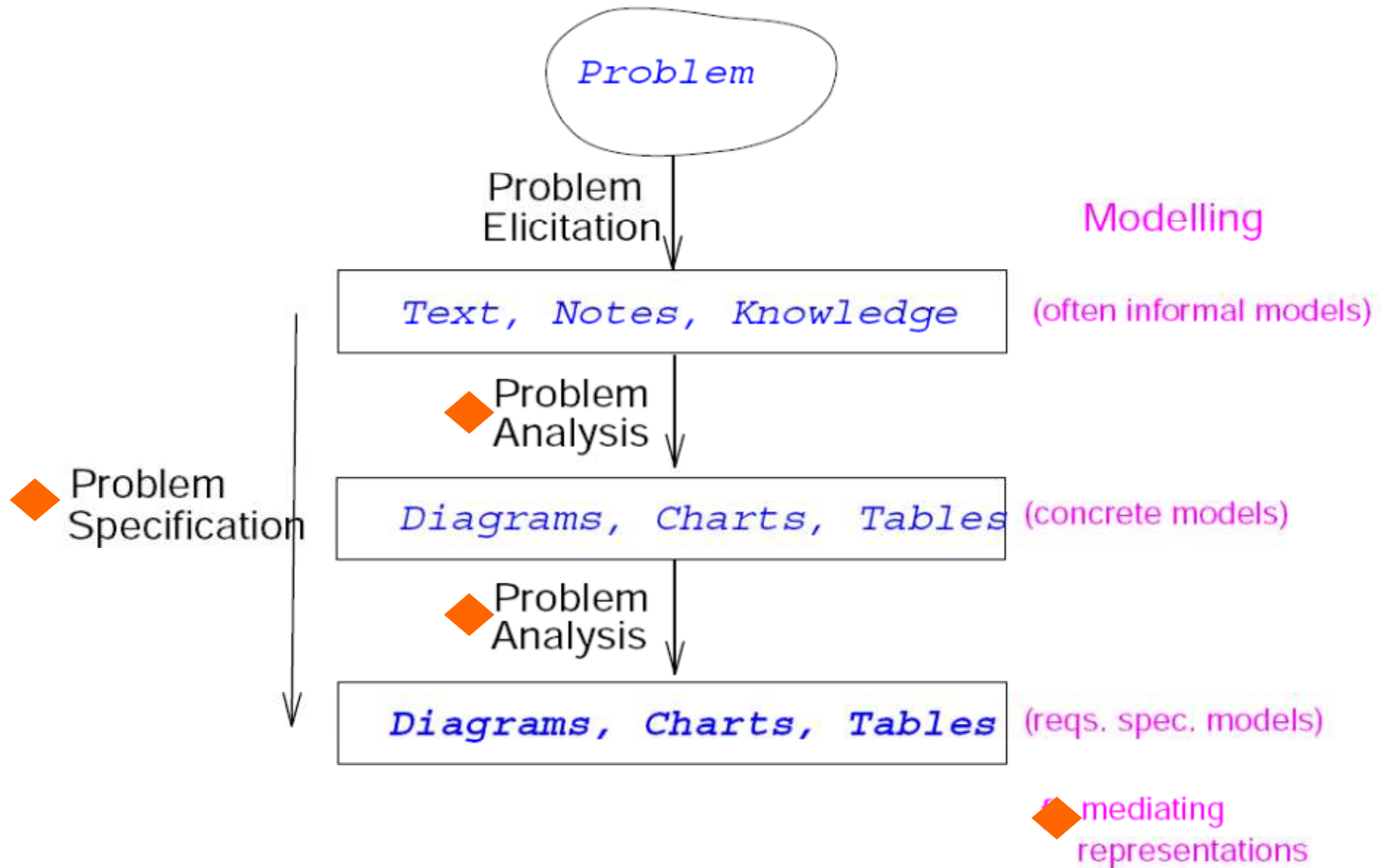
# What is a *Model*?

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# Requirements Analysis, Modeling & Specification

A continuous loop



It is more important to understand the problem than the solution. [Albert Einstein]

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“A problem unstated is a problem unsolved”

Douglas Ross, 1977

From Sam Supakkul's presentation

# What is a problem?

## Is storm coming a problem?



<http://www.dynsthe/images/Lighting/cides/2008-06-02-1818-Kamponkong.jpg>

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Yes, if we want to have outdoor fun

Problem



<http://www.alphakings.co.uk/alphakings.co.uk/Outdoor/33Party/33Dress.jpg>

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# No, if we're dying for it



Blessing



<http://www.alphaberg.co.uk/alphaberg.co.uk/Outdoor%20Party%20Dance.jpg>

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# Problem or not depending on the goal we have

Problem



Blessing





# What is a problem?





Goals



Problems



Alternatives



Selection

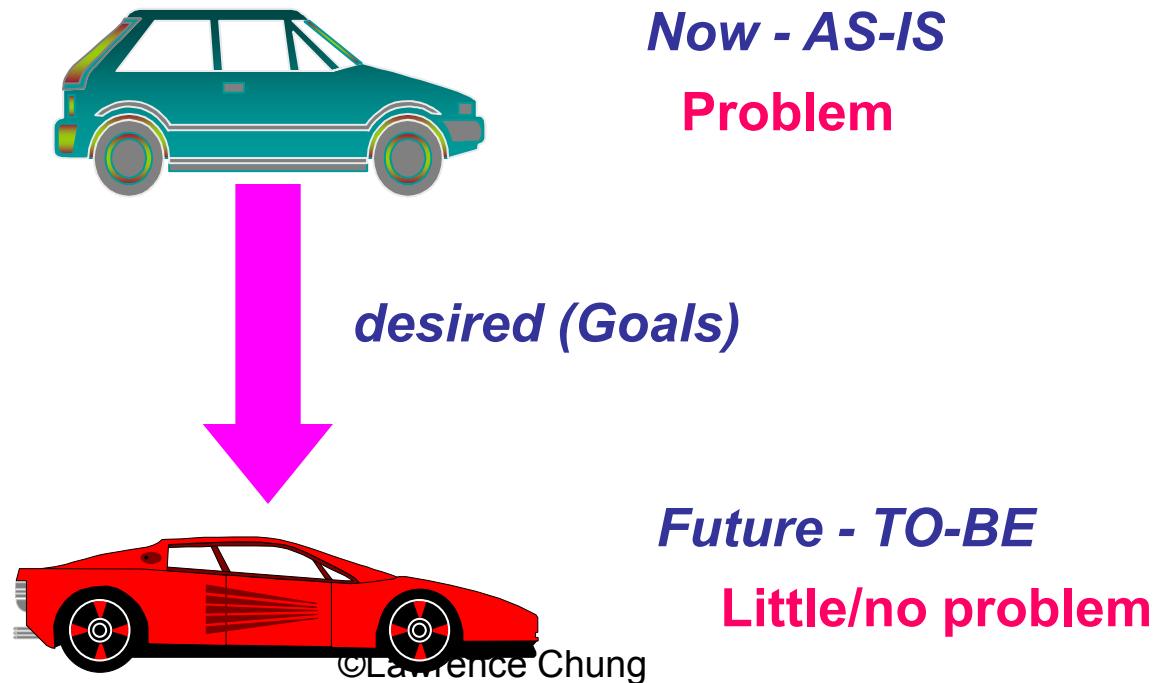
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[http://1.adam.com/blog/stop\\_sign.png](http://1.adam.com/blog/stop_sign.png)  
<http://www.civilnet.com/wordpress/wp-content/uploads/2009/02/choice1.jpg>  
<http://uplmsdoc.com/blog/wp-content/uploads/2009/02/choice1.jpg>

# Problem = TO-BE – AS-IS

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It is more important to understand the problem than the solution. [Albert Einstein]

A problem can be defined as the difference between things as *they are now* and things as *they are desired*.



# Exercise: Student Application Processing System

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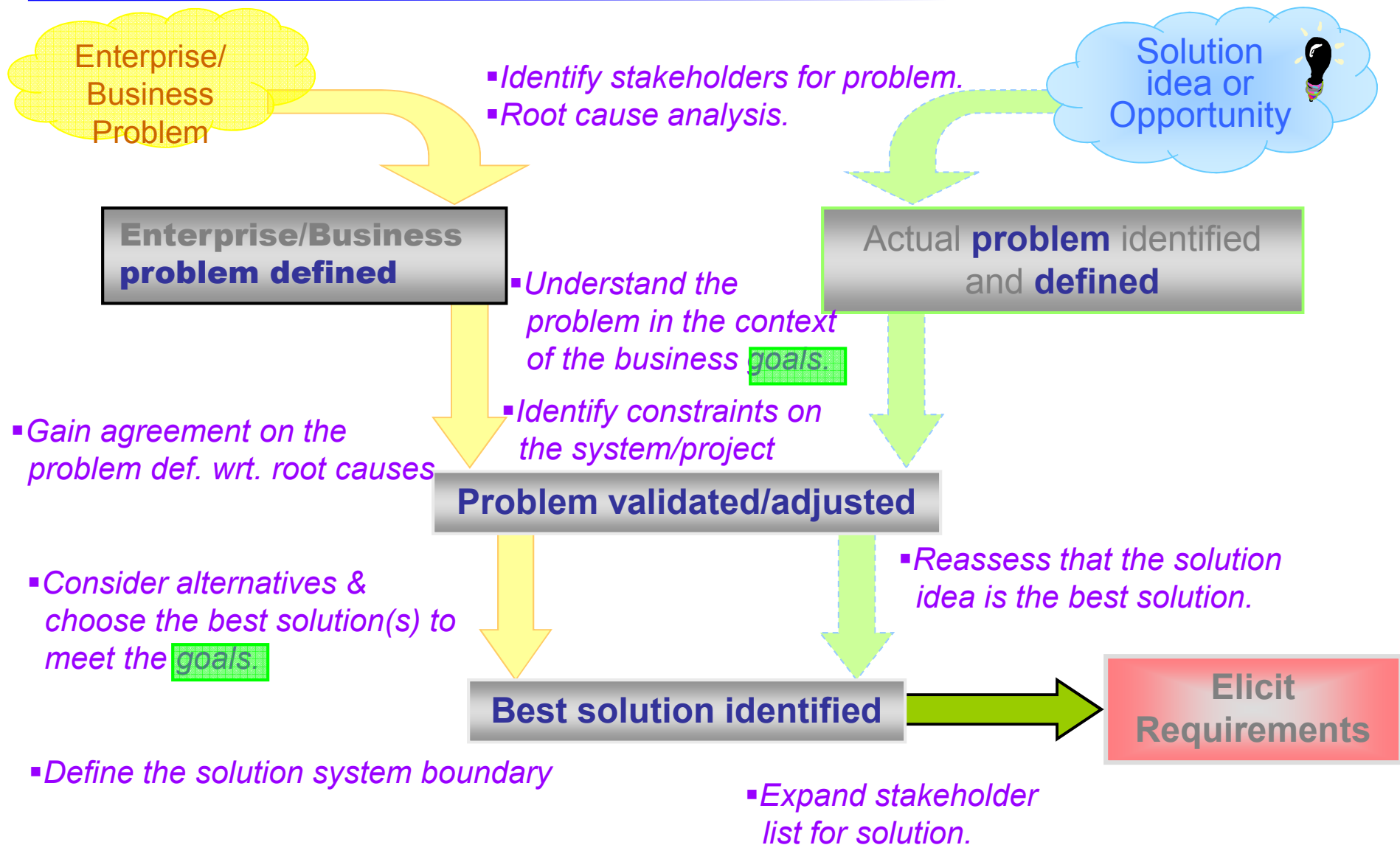
*(AS-IS)*

**(Problem)**

*(TO-BE)*

To be continued later ...

# A Problem Analysis Roadmap



❑ Establish common vocabulary => Glossary with a Domain Model



**One Man's Ceiling is Another Man's Floor!**

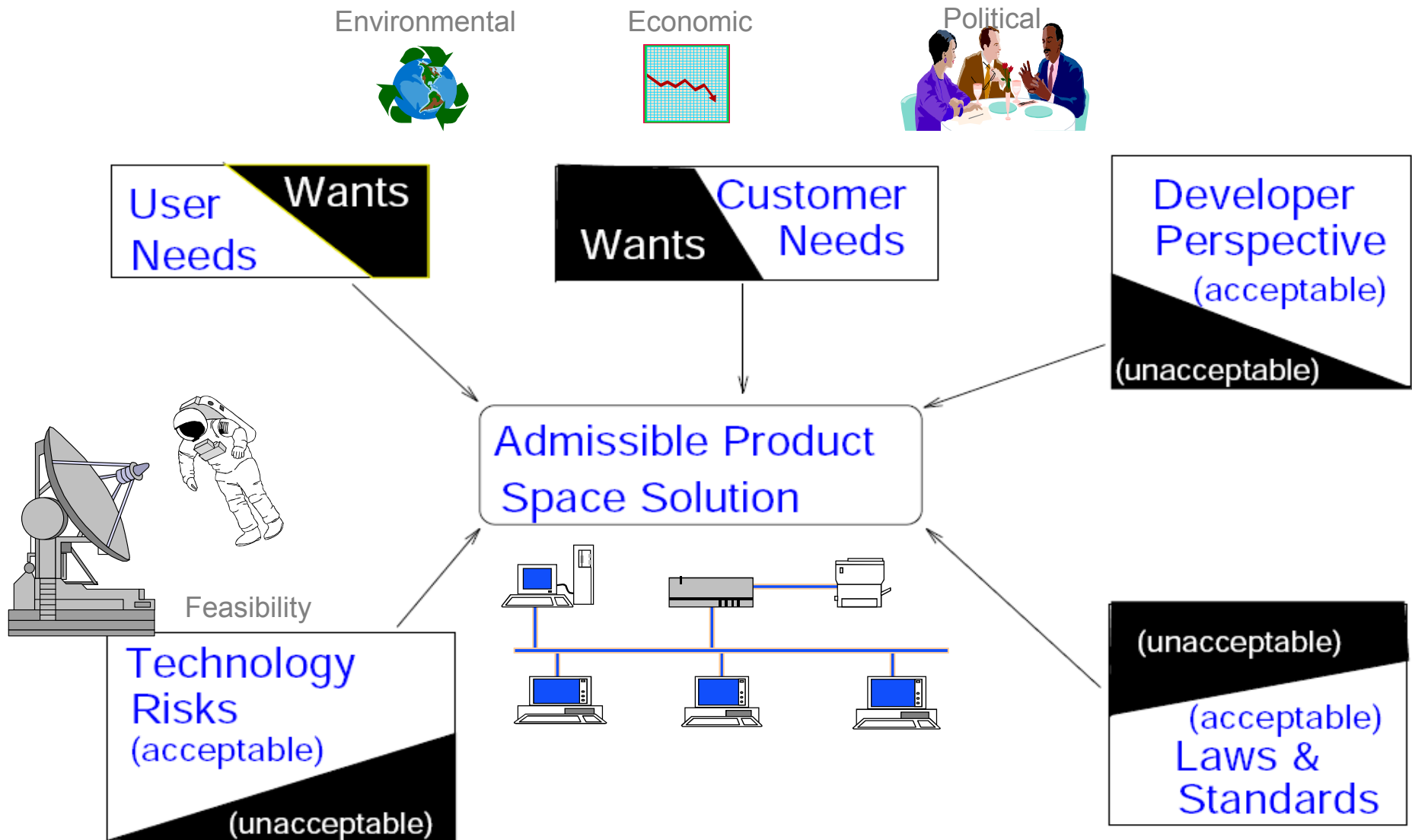
**One Man's Problem is Another Man's Solution!**

**One Man's Floor is Another Man's Ceiling!**

**One Man's Solution is Another Man's Problem!**

# Carving the Product Space

*Requirements represent a compromise.*





# Carving the Product Space

*Requirements represent a compromise.*

## Example

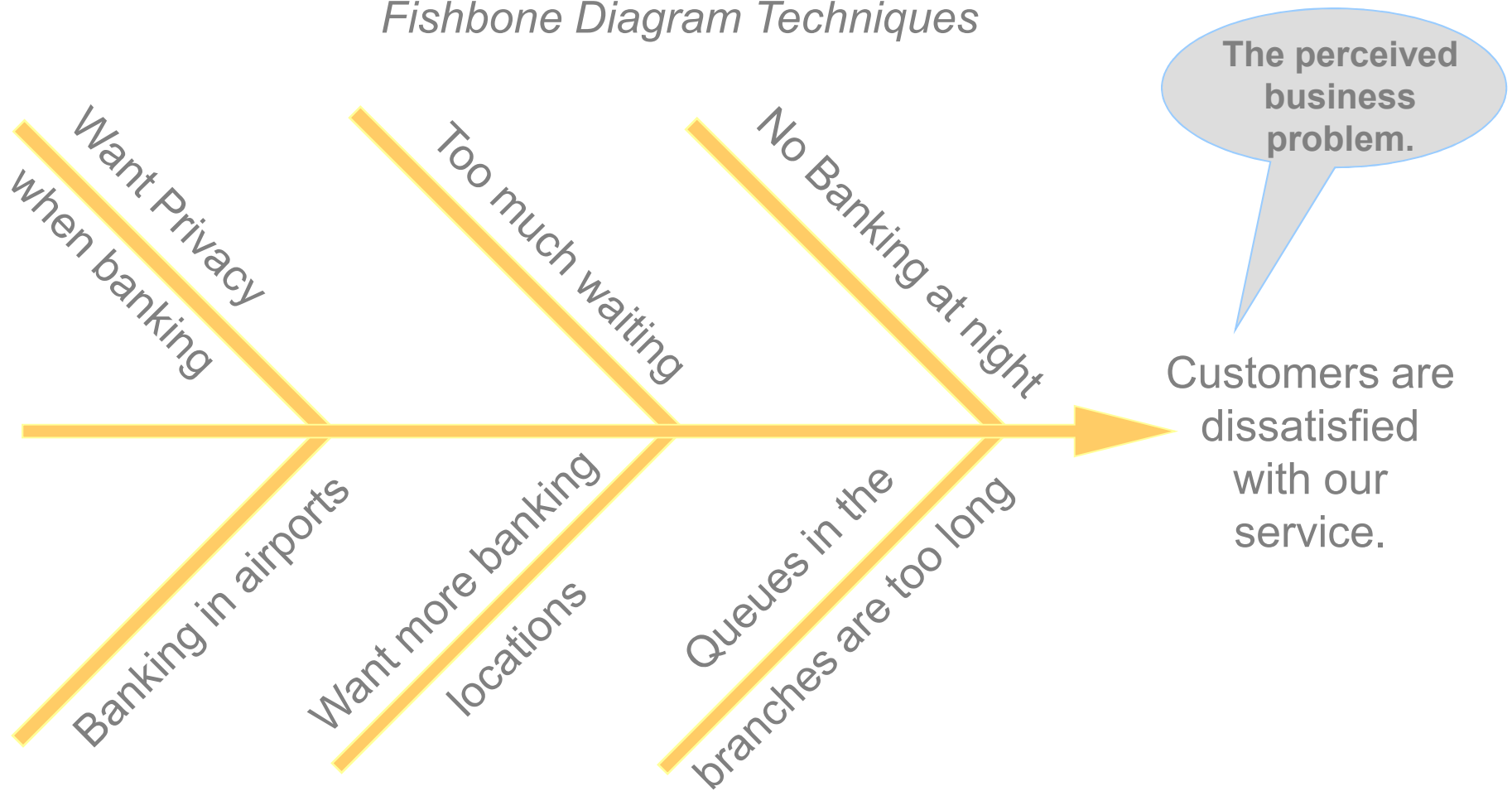
E.g., Wired/Wireless phone & PCS



Varying degrees of acceptable/unacceptable solutions

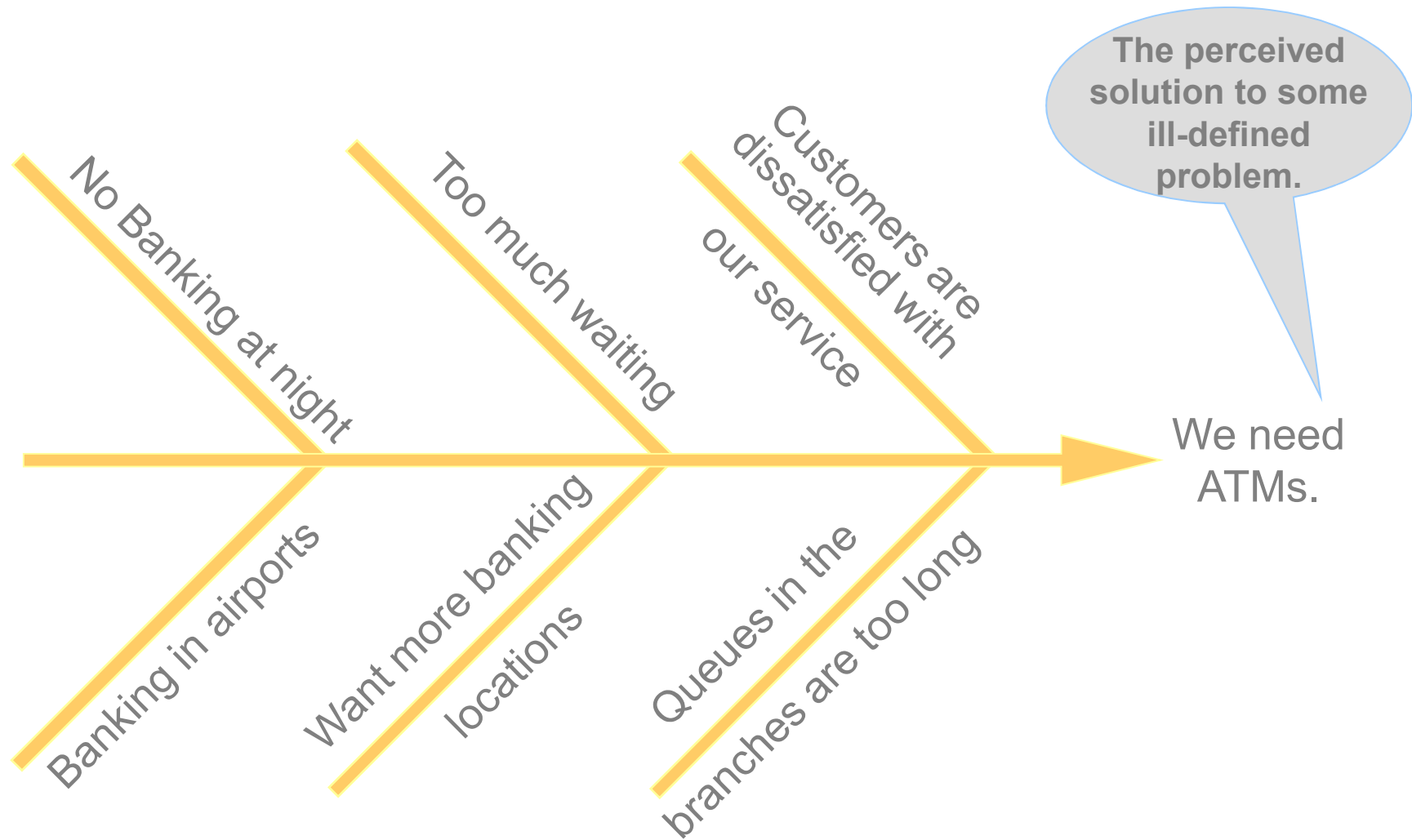
# What Is the Problem Behind the Problem?

## *Fishbone Diagram Techniques*



List contributing causes to the identified problem.  
Keep asking “**Why?**” (expand each rib).

# Problem Analysis – Validating a Solution



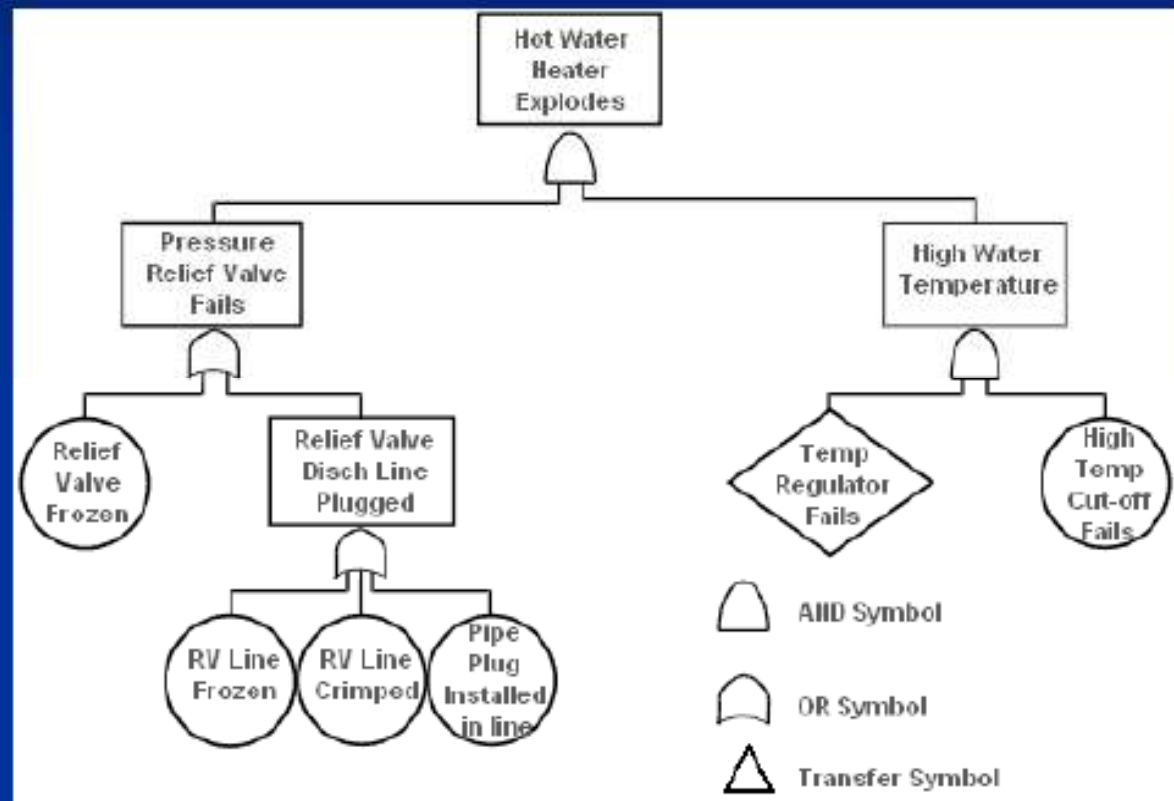
List the reasons why the solution is the right solution.  
Keep asking “**Why?**” (expand each rib).

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**What is the problem of your project? Why is your solution the right solution?**

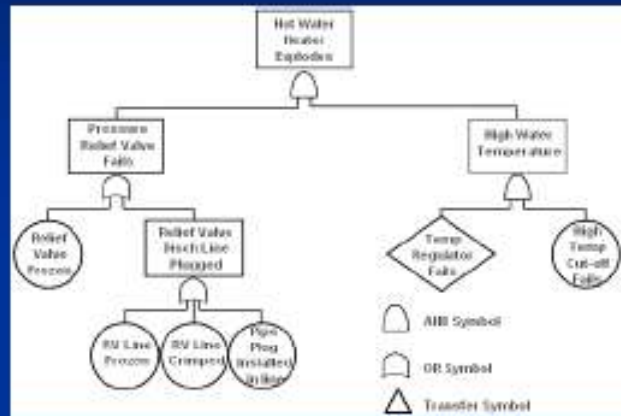
# Representation of problems

## fault tree diagram



# Representation of problems

## fault tree diagram



- Clear relationships between siblings

- AND/OR

- No relationship with

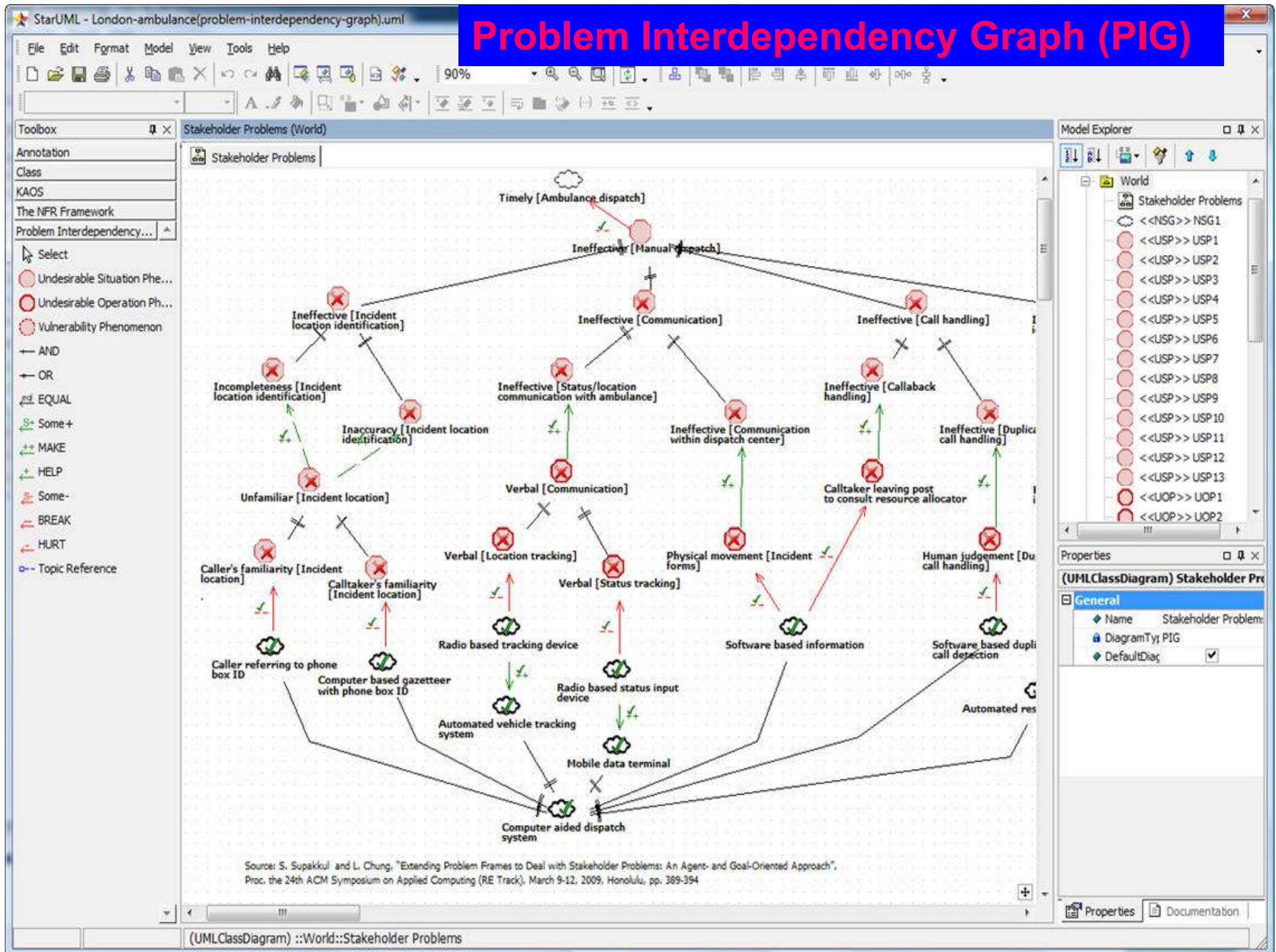
- Goals

- Alternatives





# Problem Interdependency Graph (PIG)



***But what if there are too many problems?***

## **Pareto principle**

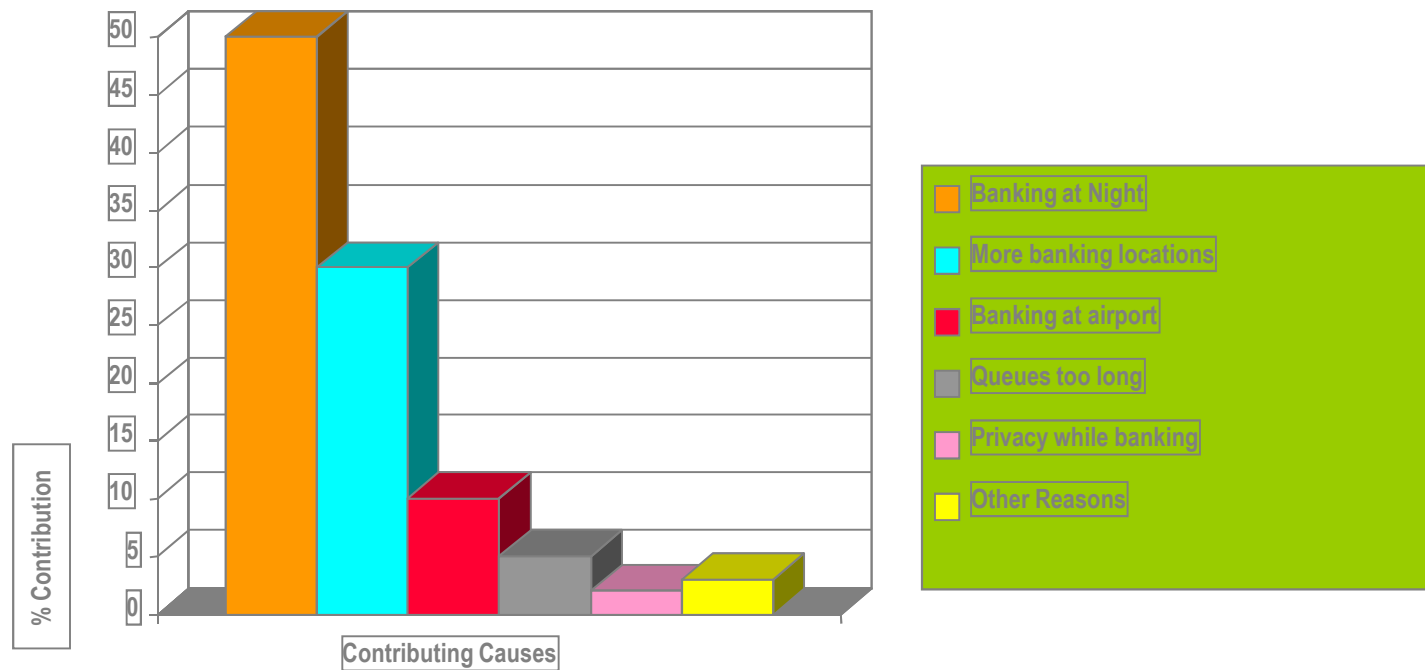
### **In economics**

The original observation was in connection with income and wealth. Pareto noticed that 80% of Italy's wealth was owned by 20% of the population.<sup>[4]</sup> He then carried out surveys on a variety of other countries and found to his surprise that a similar distribution applied. [Wikipedia]

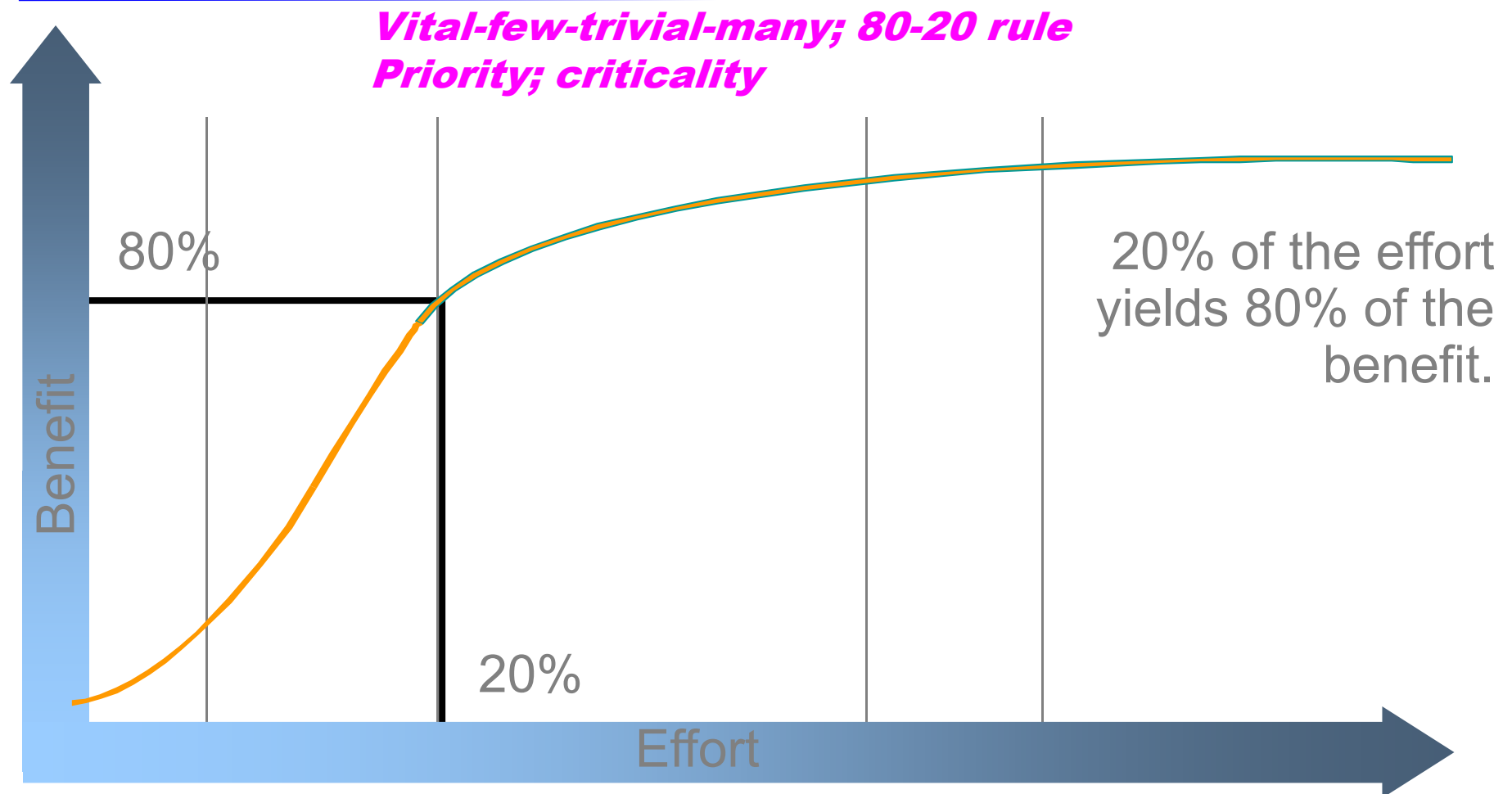


# Pareto effect Analysis

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# Focus on Largest Contributors - *Pareto's Law*



Rank in order. Use the 80-20 Rule to focus on the top contributing causes to address the greatest portion of the problem.

***What are in the 20% of the problem of your project?***

# Requirements Prioritization

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*An Analytic Hierarchy Process (AHP) Approach* [Karlsson & Ryan 1997]

**Given n requirements,**

- Create n x n matrix
- Compare each pair

- entry (i, j) =

- 1 if i and j are of equal value
    - 3 if i is slightly more preferred than j
    - 5 if i is strongly more preferred than j
    - 7 if i is very strongly more preferred than j
    - 9 if i is extremely more preferred than j

} subjective/  
ad hoc

- entry (j, i) =  $1/\text{entry}(i, j)$

- Estimate the eigenvalues

- Calculate the sum of each column
  - Divide each entry by the sum of its column
  - Calculate the sum of each row
  - Divide each row sum by n

This gives a value for each requirement based on estimated percentage of total value of the project

# Requirements Prioritization

*An Analytic Hierarchy Process (AHP) Approach*

## Example

	r1	r2	r3	r4
r1	1	1/3	2	4
r2	3	1	5	3
r3	1/2	1/5	1	1/3
r4	1/4	1/3	3	1

*normalize columns*

	r1	r2	r3	r4
r1	0.21	0.18	0.18	0.48
r2	0.63	0.54	0.45	0.36
r3	0.11	0.11	0.09	0.04
r4	0.05	0.18	0.27	0.12

*sum the rows*

sum	Sum/4
1.05	0.26
1.98	0.50
0.34	0.09
0.62	0.16

\*Also should compute the consistency index,  
since the pairwise comparisons may be inconsistent

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?

# Using "Shall" and Related Words

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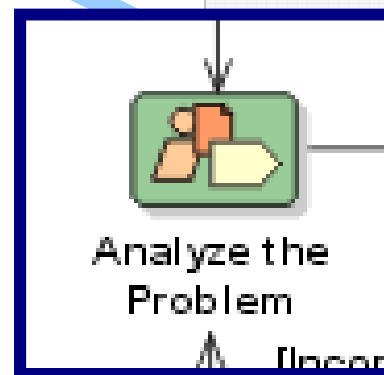
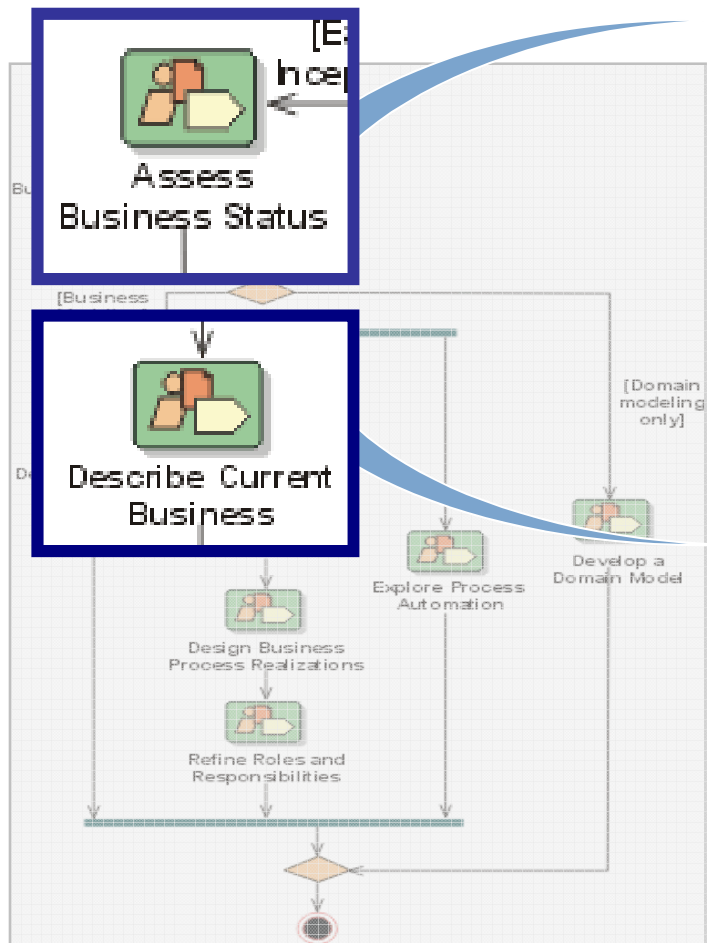
- "**shall**" indicates a binding provision, i.e., one that must be implemented by the specification users.
- To state non-binding provisions, use "**should**" or "**may**."
- Use "**will**" to express a declaration of purpose (e.g., "The government will furnish ...") or to express future tense

- Appendix

# D, S achieves R to solve P in D

Domain/World/Enterprise/Business

D, P Problem => R Requirements => S Specification



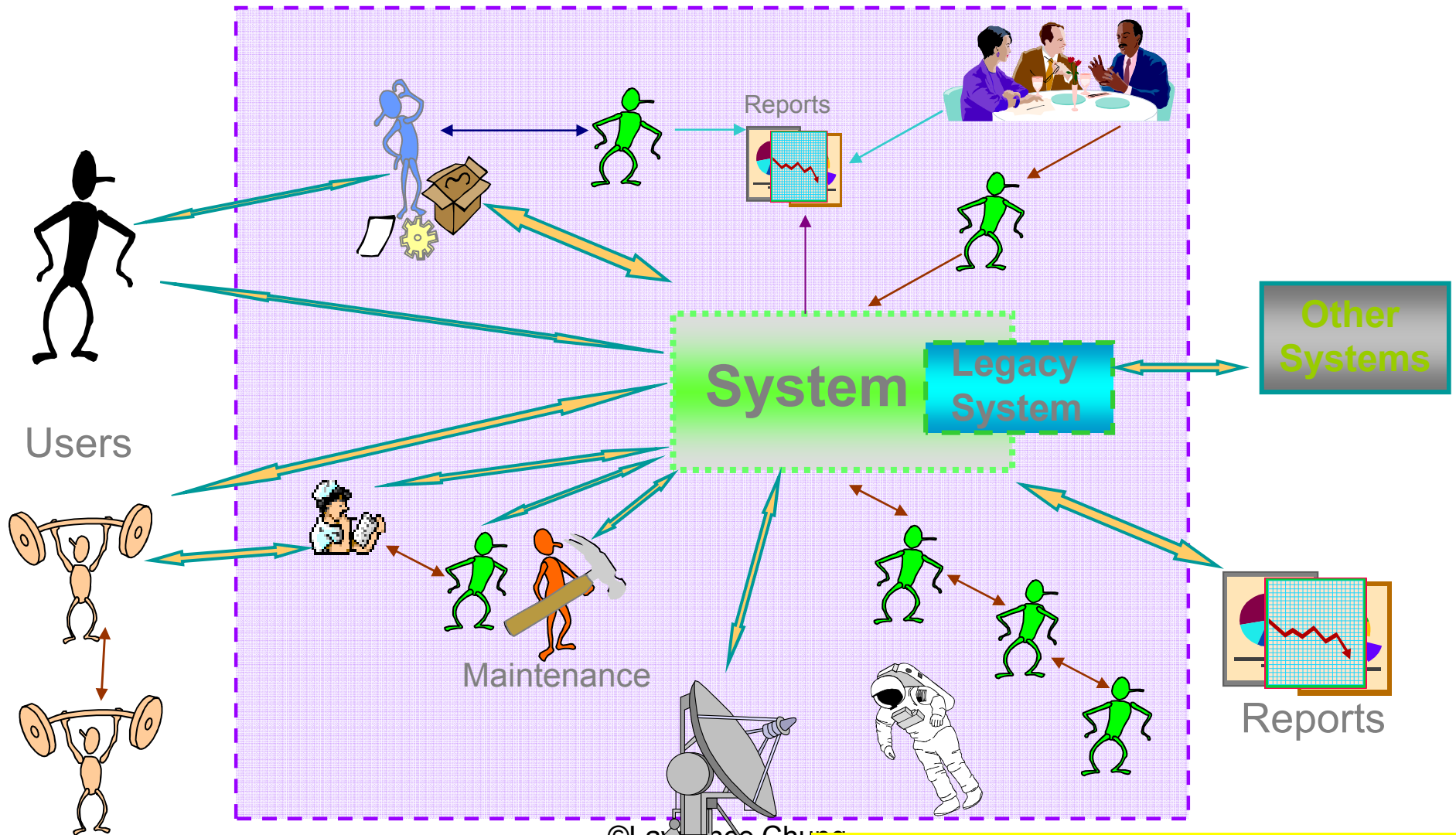
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What next?



# D, S achieves R to solve P in D

Define Boundaries for the Enterprise/Business and the Solution



Consider Application Processing

More on this in Enterprise Modeling

**D**, **S** achieves **R** to satisfy/satisfice **G** (solve **P**) in **D**

$M^G, \text{Prog}^G \models S^G; S^G, D^G \models R^G; R^G, D^G \models G; (G \models \neg P) \vee (G \models \sim \neg P)$

## Exercise

### An Application Processing System

**D**: include a functional model, a workflow model, an informational model, a BM

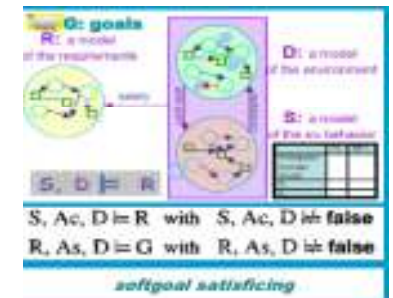
**P**: include complaints (both external and internal), weaknesses, etc.

**G**: include wants and needs countering **P** – both hard and soft

**R**: include an interaction model between **D** and **S**

**S**: include a functional model, an informational model, a behavioral model

Requirements should contain *nothing but* information about the environment.



# Modeling is Everywhere

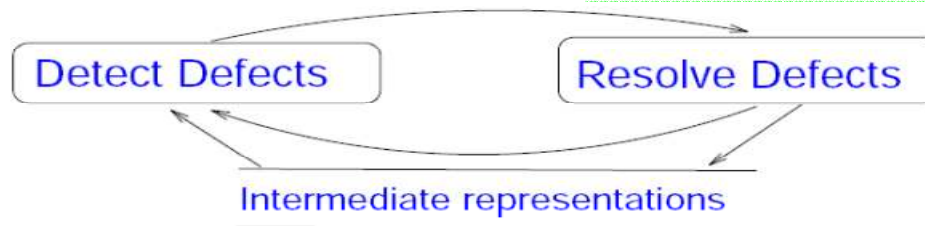
## Problem Elicitation

exploratory, brain-storming, open-ended thinking  
elaboration of unclear goals and needs  
identification of sources, views, needs & wants

*Wicked Problem*

## Problem Analysis

*process of understanding real-world problems, how they relate to stakeholder needs, and proposing solutions to meet those needs.*



- One Man's Ceiling is Another Man's Floor!**
- ◆ determination of "real" users ( $\leq$  identification of sources)  
(e.g., stratification during sampling, questionnaires & interviewing)  
customers, tellers, other employees
  - ◆ clarification of goals (e.g, Goal-directed approach)
  - ◆ detecting differences in views and integrating them, & recording rationale
  - ◆ resolving a mishmash of wants and needs
  - ◆ prioritization of defects
  - ◆ understanding (all constraints on the) solutions and evaluating them
  - ◆ risk analysis (e.g., scenarios)

## Problem Specification

- ◆ choose formal notations
- ◆ create a formal model of the requirements

## Modeling is NOT Perfect

[adapted from Jackson, 1995, p124-5]

- There will always be phenomena in the model that are not present in the application domain
- There will always be phenomena in the application domain that are not in the model
- Perfecting the model is not always a good use of your time

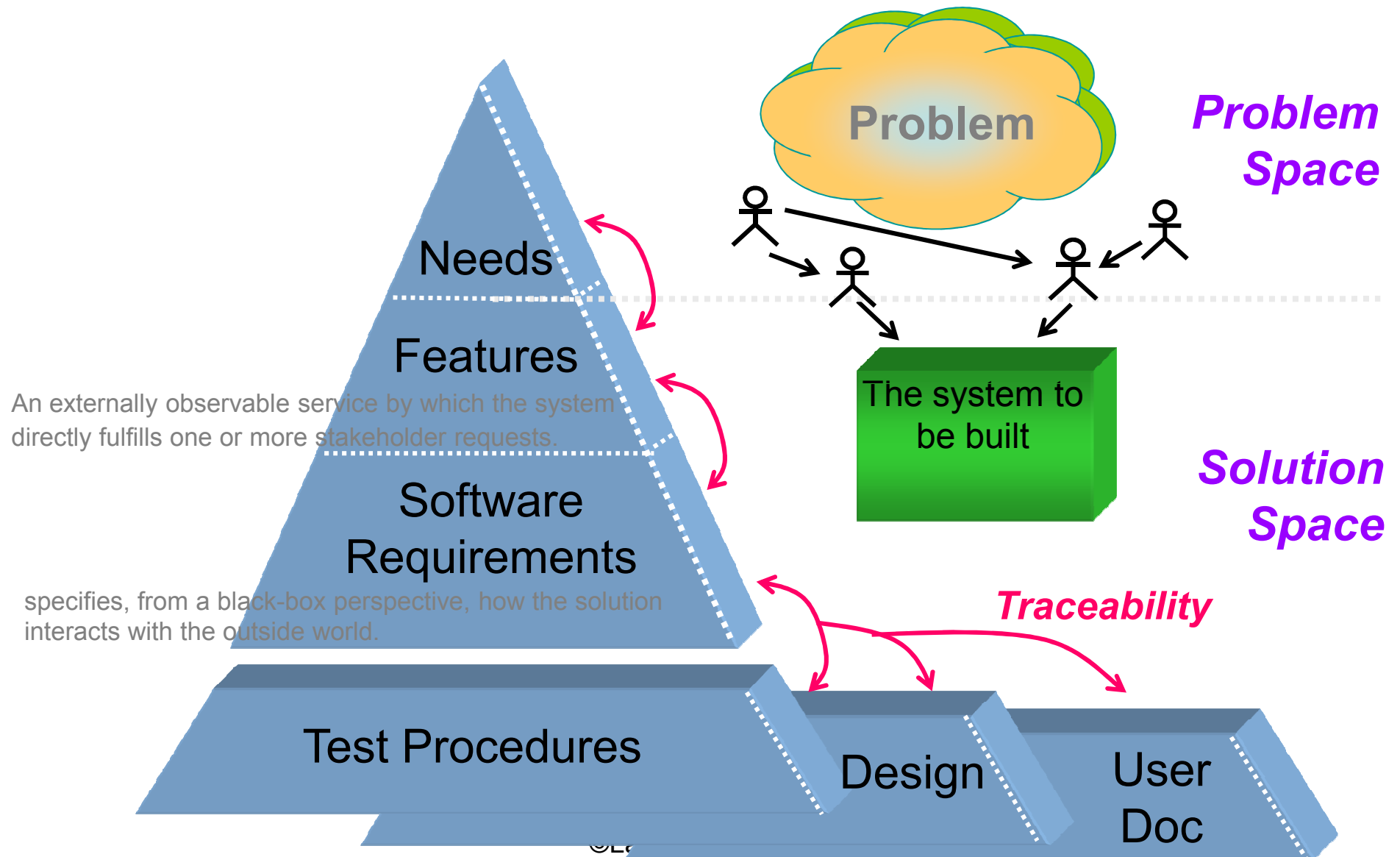
# Stakeholders in the Vision Document

Stakeholder - An individual who is materially affected by the outcome of the system or the project(s) producing the system.

Who are some of the stakeholders for your projects?

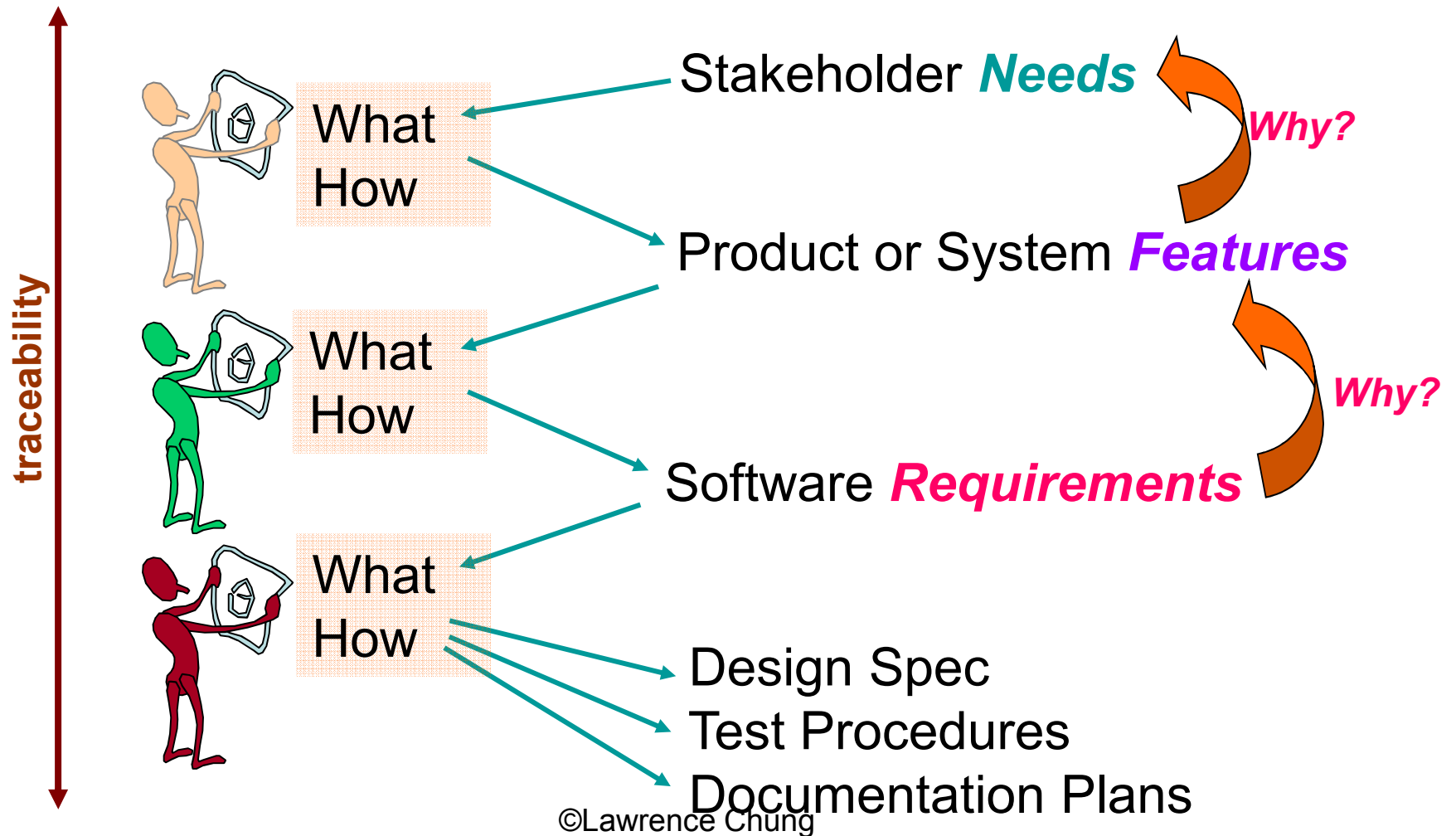
Stakeholder	Registrar
Representative	Kelly Hansen
Description	User
Type	The Registrar is typically a college-educated professional with full computer skills. The Registrar is trained and experienced with the use of the current batch-oriented registration .
Responsibilities	The Registrar is responsible for administering course registration for each school term. This includes supervising administrative and data entry personnel.
Success Criteria	The registrar's primary responsibility will be maintaining student and professor databases, and opening/closing courses to registration. The registrar's office will also be required to perform ....
Involvement	The registrar's primary responsibility will be maintaining student and professor databases, and opening/closing courses to registration. The registrar's office will also be required to perform.....
Deliverables	Management reviewer – especially related to functionality and usability of features required by the Registrar staff.
Comments/ Concerns	None ©Lawrence Chung

# Carving the Product Space



# Carving the Product Space

*Requirements exist at many levels of abstraction,  
possibly with diff. terminology*



One Man's Ceiling is Another Man's Floor!