
Engineering 405

Problem Solving,
Troubleshooting,
Entrepreneurship
and
Making the Transition to the Work place

Lecture 1

Today's Lecture 9/6/16

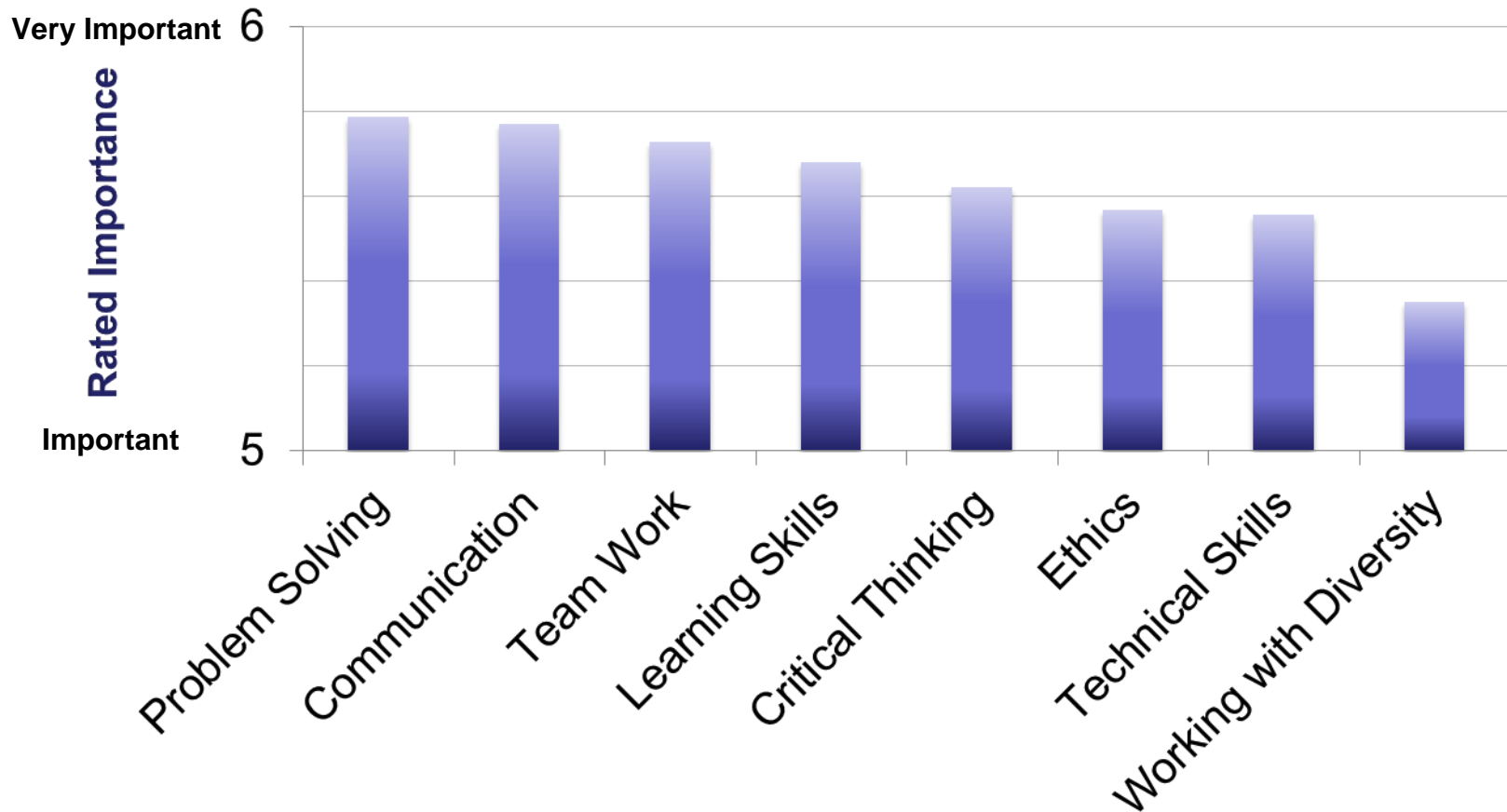
Problem Solving Strategies—Why Bother??

Introduction to the Course

Problem Solving Strategies, Why Bother?

Joel Barker: Discovering the Future

Relative Importance of Skills for Employers



National Science Foundation Grant

\$350,000 National Science Foundation Grant
to Research Problem Solving



		1025
DATE <u>mm/dd/yyyy</u>		
PAY TO THE ORDER OF	H. Scott Fogler	\$ 350,000
Three Hundred and Fifty Thousand		DOLLARS
MEMO		
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Contributing Companies

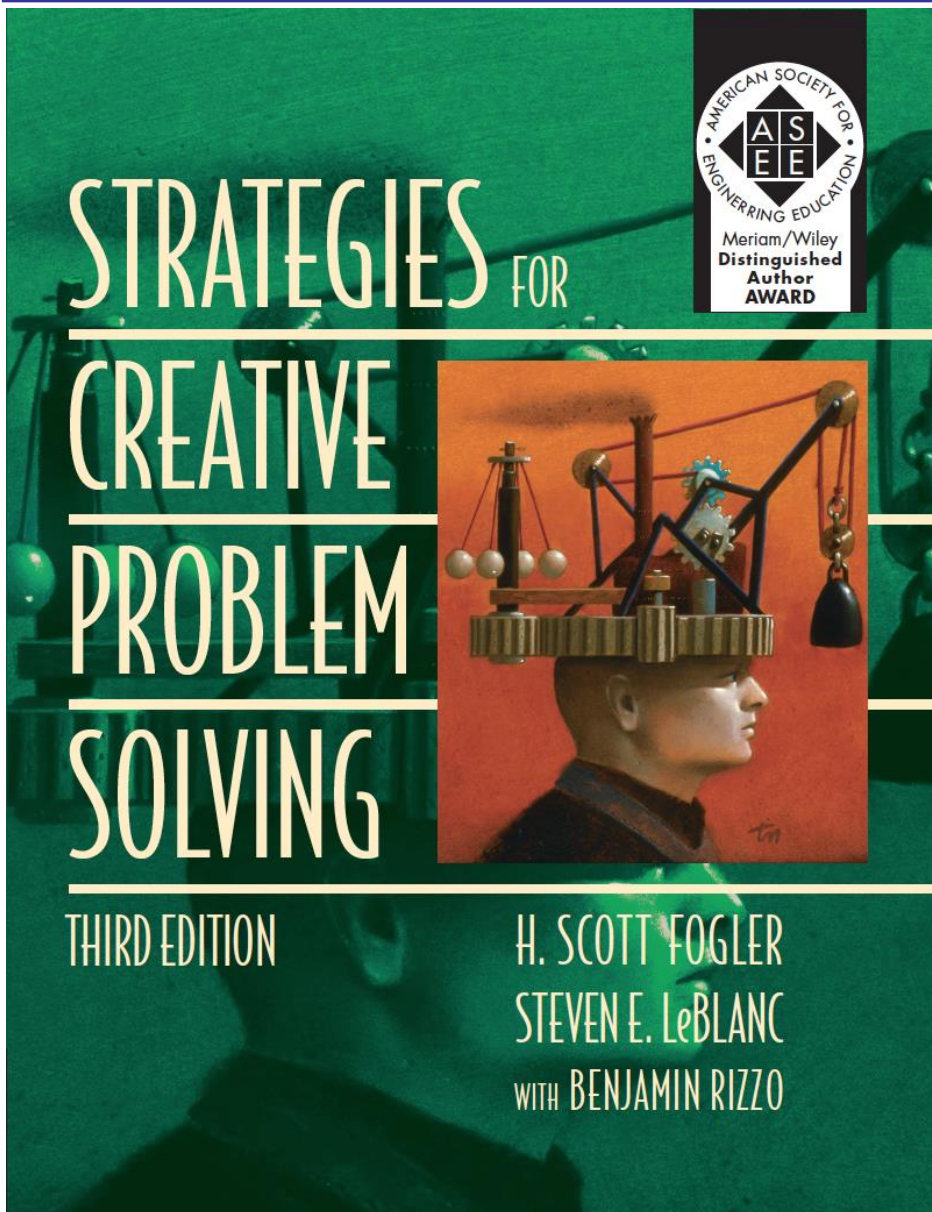


Typical Company Visit



Goal: To learn how engineers, scientists and managers went about solving problems and the techniques they used.

Chapter 1



**H. Scott Fogler
Steven E. LeBlanc
with Benjamin Rizzo**

*Strategies for Creative
Problem Solving*
Prentice Hall

3rd Edition (2014)

The greatest hurdle companies faced in Problem Solving



The greatest hurdle they faced in Problem Solving

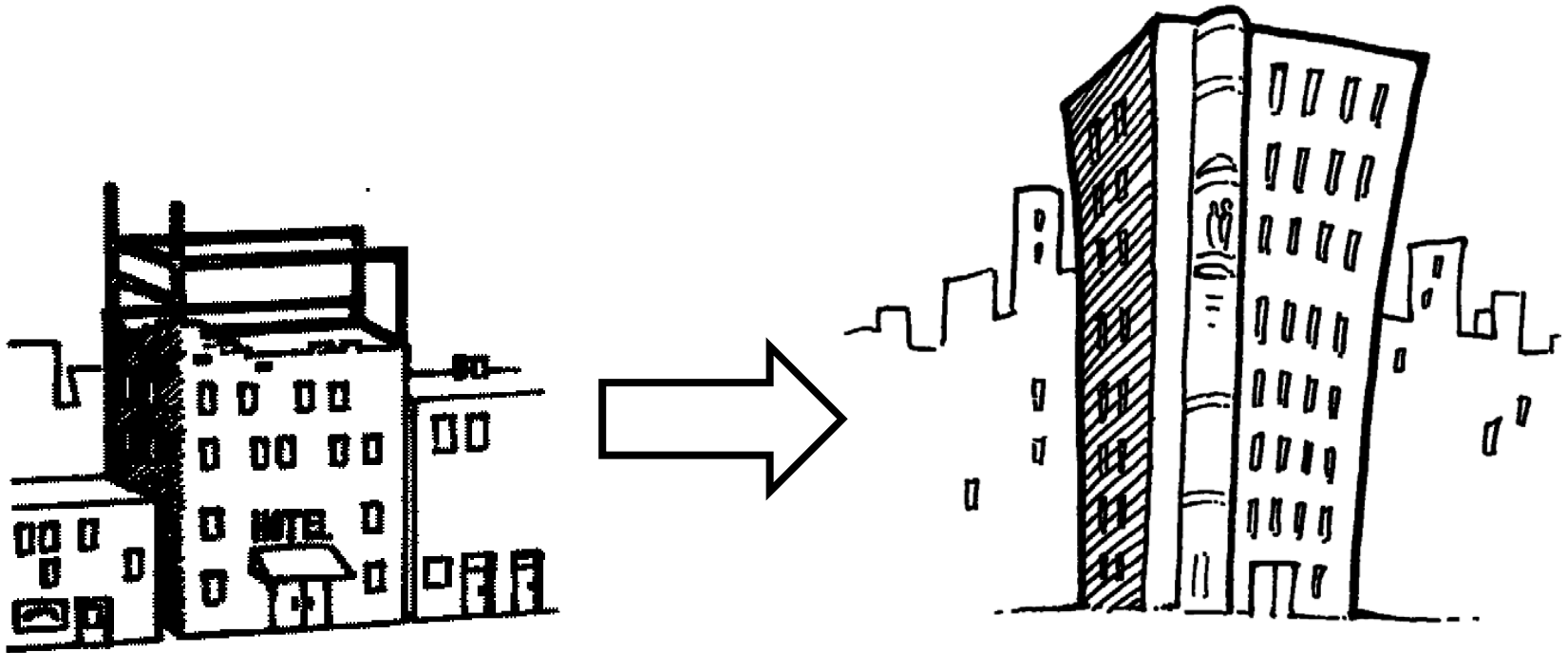


Defining the *Perceived Problem* Instead of the *Real Problem*

The Perceived Problem

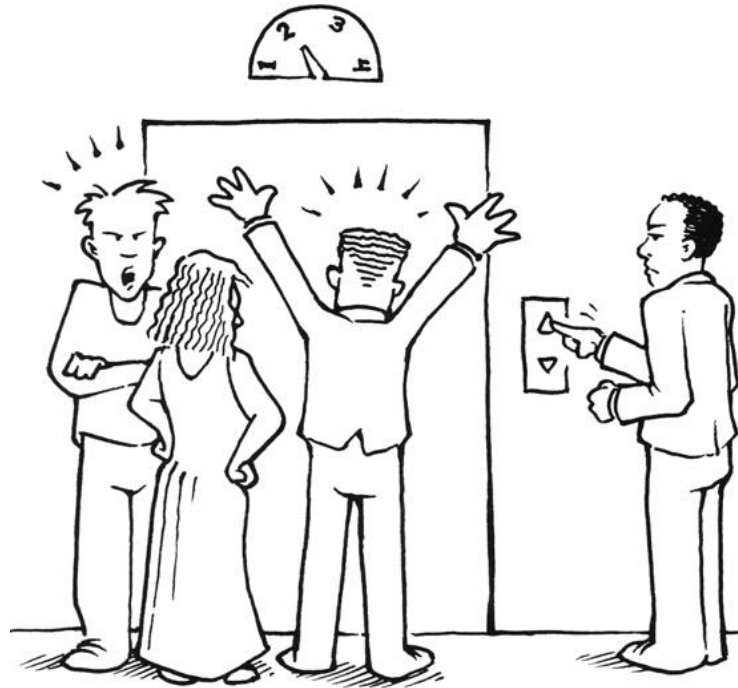


The Annoying Wait



Shortly after the upper floors of a hotel got renovated, guests started to complain that the elevators were too slow.

The Annoying Wait



The manager's instructions to solve the perceived problem:
"Find a way to speed up the elevators."

Next, the manager's directions were:
"Find a location and design a shaft to install another elevator."

Problem Solved



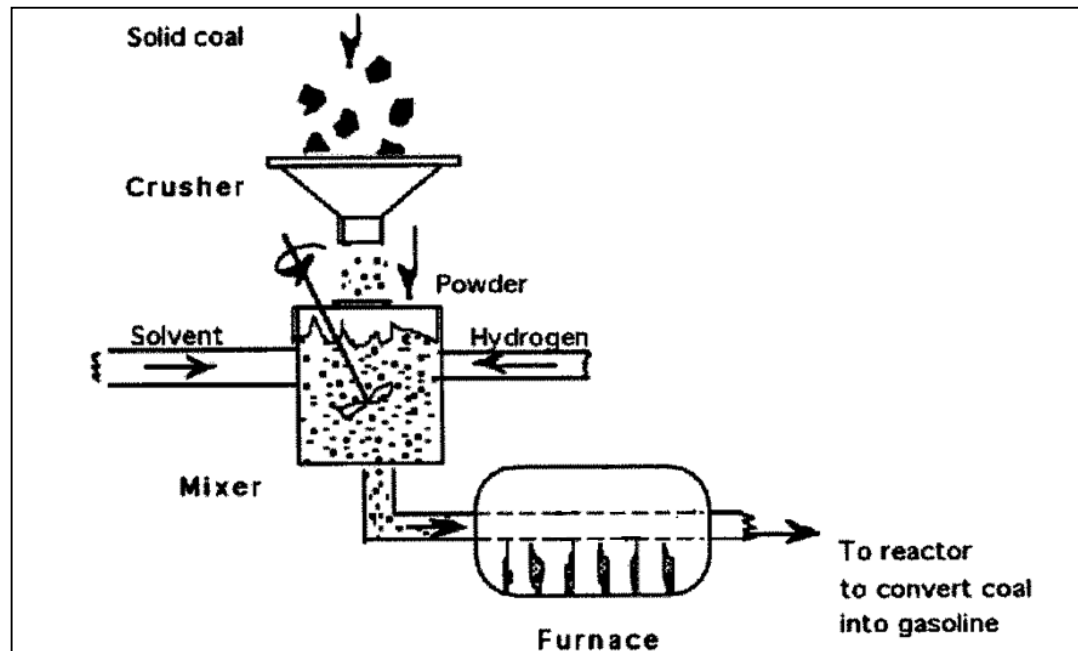
Find a Better Solvent



A few years ago a major oil company was developing a process for the Department of Energy to produce liquid petroleum products from coal in order to reduce the U.S. dependence on foreign oil.

The Better Solvent

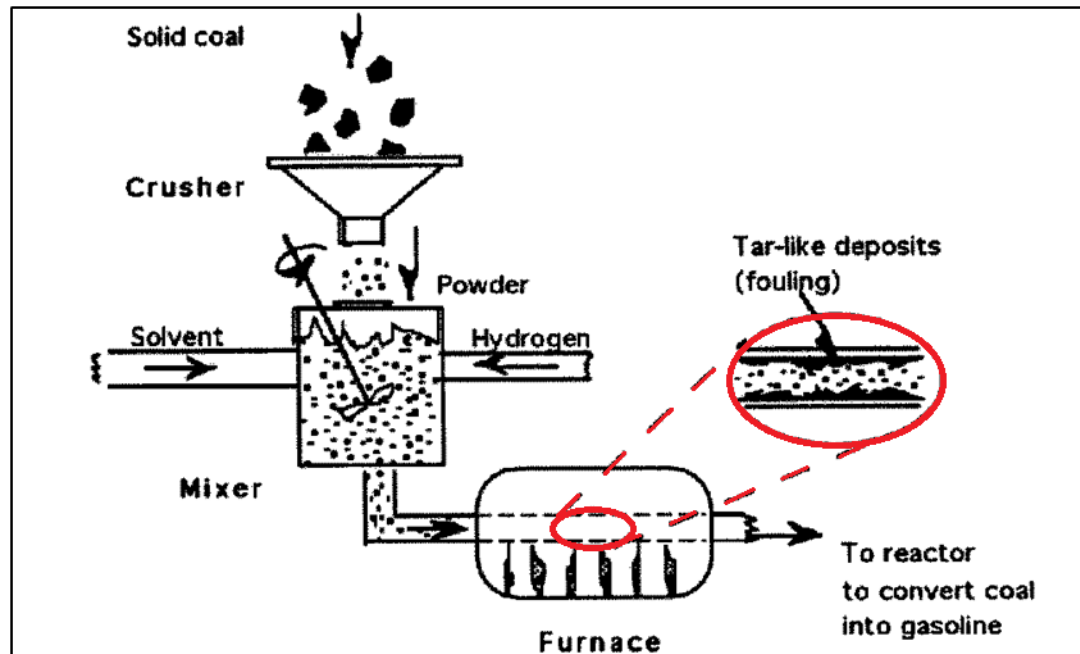
In this process, solid coal particles were ground up, mixed with solvent and hydrogen, then passed through a furnace heater to a reactor that would convert the coal to gasoline.



The Better Solvent

Sometime after installation excessive amounts of a tar-like material were being deposited on the pipes in the furnace, causing fouling and plugging. Management told its engineers

“Find a better solvent”

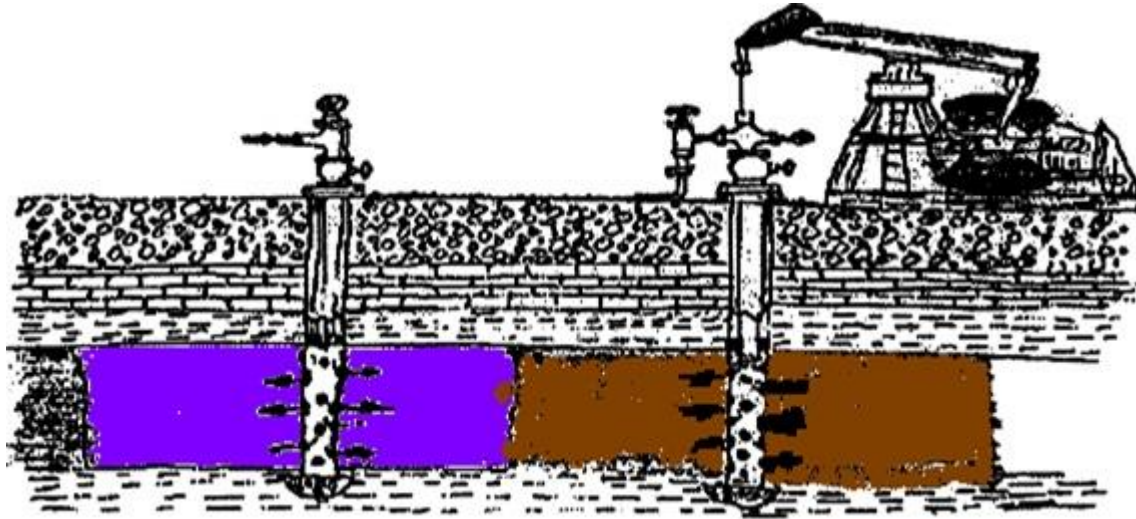


The Better Solvent

- Why is the Deposit Forming?
- Brainstorm and List all the Possible Causes.



Improving Oil Recovery



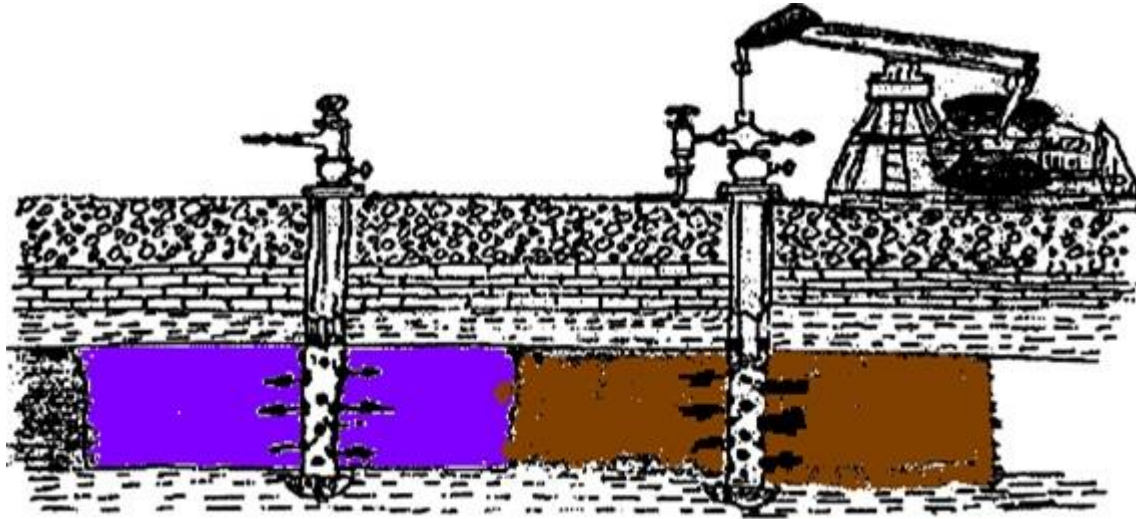
Perceived Problem Statement:

“Find ways to improve oil recovery”

Proposed Solution to Solve the Perceived Problem

Inject Better Surfactants and Viscosifiers

Improving Oil Recovery



Perceived Problem Statement:

“Find ways to improve oil recovery”

Real Problem Statement

“Learn why the well is not producing as expected”

New Bills Smeared



Perceived Problem Statement:
“Find a Better Printing Ink”

New Bills Smeared: Find a Better Printing Ink



Better Problem Statement.

- **Brainstorm and List all the things that could cause the ink to smear.**

Murray River Dams

Right Problem Definition

BUT

Wrong Solution

Grow agriculture crops in arid land



Grow Agriculture Crops in Arid Land

The following solution was chosen by the Australian government:

“Design and build a dam to divert the river water inland to irrigate the land.”



Murray River Flows From the Mountains to the Sea



Build Dams along the Murrumbidgee River



Dam the Torpedo or Torpedo the Dam?

The following solution was chosen by the Australian government:

“Design and build a dam to divert the river water inland to irrigate the land.”

Unfortunately, no new vegetation grew.



London Underground

Right Problem Definition

BUT

Wrong Solution

Jubilee Line



Jubilee Line



Jubilee Line



Jubilee Line



Always Carry Out a Potential Problem Analysis

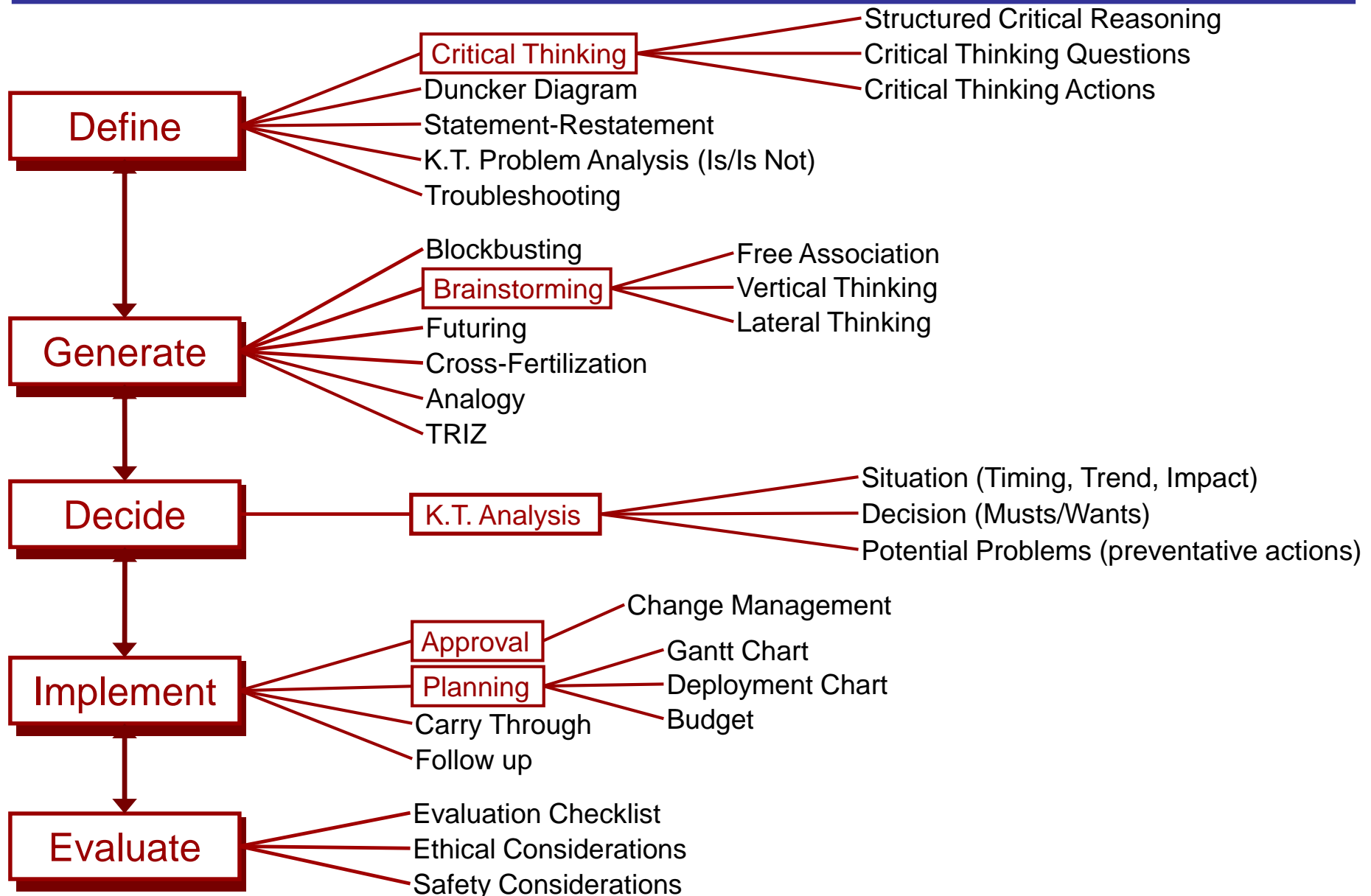


What Could Go Wrong?

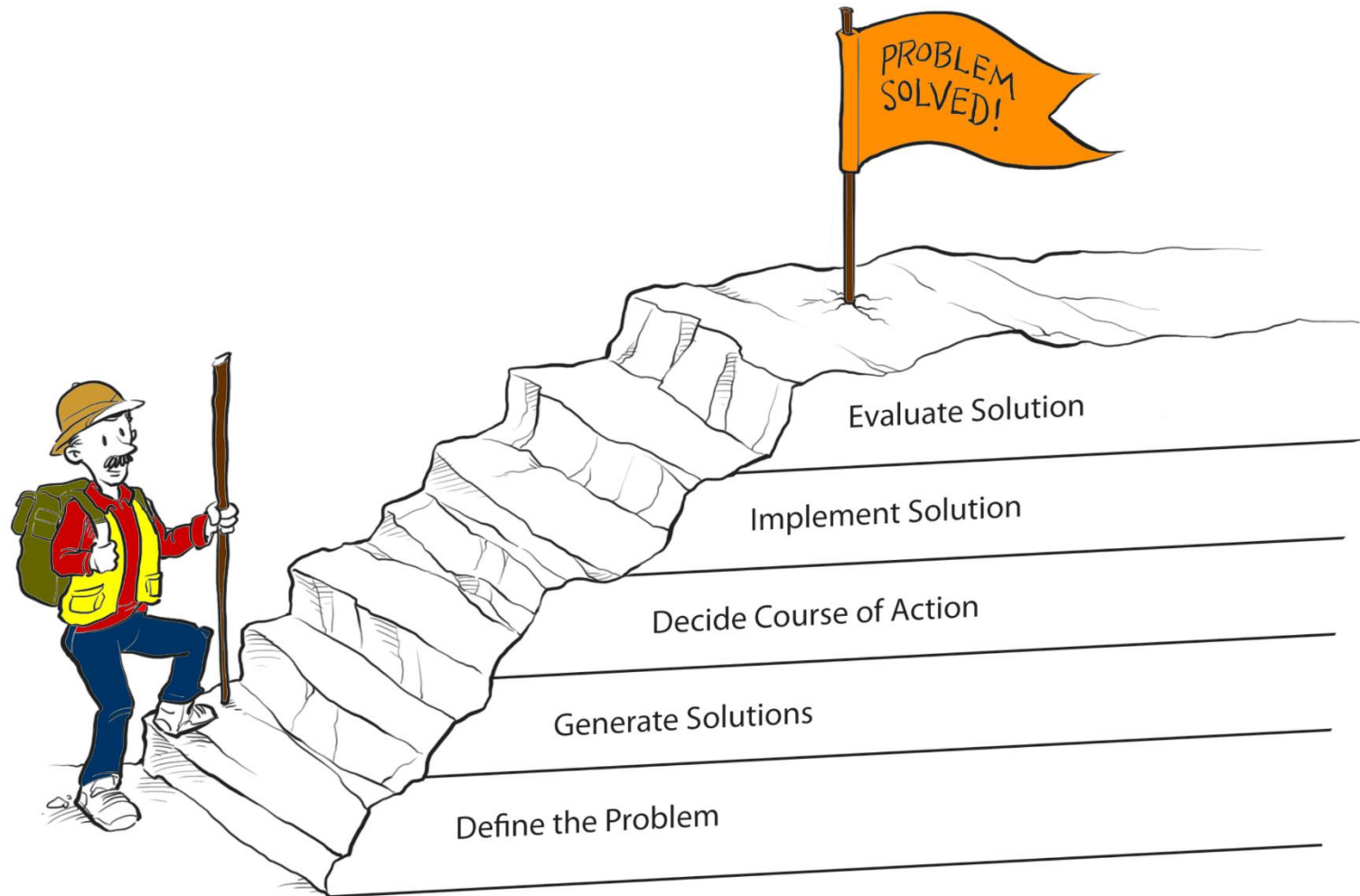
K.T. Potential Problem Analysis

1. Brainstorming a list of all the potential problems
2. For each problem identified, brainstorm all the possible causes to that problem
3. For each cause, brainstorm a list of preventive actions.
4. For each problem, brainstorm a list of contingency actions if your preventive actions fail to prevent the problem from occurring.

Components of the Heuristic



The Five Steps of the Heuristic



Engr 405 / ChE 598

Fall 2016 Term Projects

<u>Business</u>	<u>Contact</u>
1. The Big Salad 2793 Plymouth Rd.	Kevin , 734-____-____ email
2. Orange Leaf Yogurt 2216 S. Main Street	Danielle MacFarlan, 734-369-4362 manager.orangeleaffaa@gmail.com
3. Orange Leaf Yogurt 2613 Plymouth Rd	Danielle MacFarlan, 734-369-4362 manager.orangeleaffaa@gmail.com
Possible, if renovation is completed: 4. The Wine Seller 2721 Plymouth Rd	Swetang Pater, 734-604-2812 734-668-8086 (wine store) swetangp@gmail.com
Possible: 5. Zingerman's Coffee Co.	Steve Mangigian

Grading

- **Weekly Projects** 25-35%
 - In-class Problems
 - Weekly Problem Sets
- **Exam** 15%
- **Term Project** 45-50%
- **Peer/Instructor Evaluation** 5-100%

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*"Not enough money is being spent
on safety, so be careful."*

Dam the Torpedo or Torpedo the Dam?

The Australian government wanted to increase agricultural production by finding ways to grow crops on wastelands. It was decided to cultivate land in the New South Wales region of southeastern Australia, which is very arid.

Potential Problem Analysis

Potential Problems	Possible Causes	Preventive Actions	Contingency Plan
A.	1. 2.		
B.	1. 2.		

The Goal of my research group is to *teach* research and I use the various projects that in the end will be of value to industry to do this teaching. Here we develop the scientific and engineering principles that will help industry solve there problems

Advice from Previous Classes

Top 5 Consensus Comments

- Start work on the project early
 - Mention that you've taken a problem solving class in any interviews you have and you'd be surprised how impressed people are when you can explain a KT decision analysis.
 - Pay attention to lecture. At first I thought his class was going to be a joke, I was dead wrong. I believe it helped me tremendously.
 - What you put into the class is proportional to what you will get out of it
 - Outside of class, think about situations or other classes you could apply the material: you'll surprise yourself.
-

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Dow, DuPont, Dow Corning, Amaco, Shell
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To learn how they went about solving problems
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Problem Solving

The Flames of Hope

A Berkeley physicist has found a way to help keep Darfurians alive, by building a better kitchen stove.

BY BARRETT SHERIDAN

AS FOR SO MANY of us, the genocide in Darfur was merely an abstraction to Ashok Gadgil, a scientist at the Lawrence Berkeley National Laboratory in California. But in September 2004 he got a call from the U.S. Agency for International Development. Could Gadgil design a screw press for Darfurians, the caller asked, so they could turn their garbage into biofuel pellets? "I quickly showed him that there is not enough kitchen waste in home cooking to produce much worthwhile fuel," the physicist says, and USAID dropped the idea. But the problem continued to nag at him. Eventually Gadgil decided that if he couldn't redesign the fuel, he would redesign the stove.

The violence in Darfur has not only left at least 200,000 dead but devastated the already arid landscape. More than 2 million people now fill groaning refugee camps; as they hunt farther and wider for firewood, they are denuding whole swaths of the countryside. Gathering firewood can now mean a seven-hour round trip, during which women risk rape and mutilation at the hands of the Janjaweed militias that lurk in wait. (Men can't make the trip in their stead—they'll simply be killed.) A fact-finding visit to the region in late 2005 brought home the problem's urgency to Gadgil. "A huge majority of people were missing at least one meal a week because they did not have fuel to cook with," he says. In a sick Catch-22, many families were selling some of their food in exchange for the wood to cook it with.

Gadgil, a 56-year-old Mumbai native, had experience developing simple, life-saving technology. One of his patents—a cheap method for disinfecting water using ultraviolet light—led to a success-



FUEL FOR THOUGHT: Using the stove on site, Gadgil

Gathering firewood in Darfur can mean a seven-hour round trip, during which women risk attack.

ful business start-up in 1996. The resulting company, WaterHealth International, now provides affordable clean water for more than 1 million people in the developing world. After returning from Darfur, Gadgil worked with lab colleagues and students at UC Berkeley to modify an existing Indian stove for Darfurians' needs. "Cook stoves, although they look simple, are very complex creatures," he says, "which is why you can't simply sit in Berkeley and say, 'Well, this is the stove for you.'" While the Indian stove excelled at producing low-intensity heat for cooking rice, for instance, Darfurians needed a high-powered flame for sautéing onions, garlic and okra, ingredients in their staple dish, *mulah*. And since most families cook outside, the stove also needed to cope with the region's strong winds.

The result of their efforts is the Berkeley-Darfur stove (darfurstoves.org), a hollow drum that looks like a cross be-

tween a lunar landing craft and a stop sign. Designed with a smooth airflow to fuel the fire and an upper rim that fits snugly with different-size pots, the stove requires 75 percent less wood than an open fire, and a wind collar makes for a steady flame. That means fewer risky trips outside the camp. And those

who now pay for firewood, Gadgil estimates, could save as much as \$200 a year, which could be used instead for luxuries like new clothing and fresh meat.

The next step is mass production. Gadgil and his partners in Berkeley have teamed with two nonprofits, Engineers Without Borders and CHF International, to set up workshops in Sudan. (The project is funded by USAID and individual donors.) They hope ultimately to distribute stoves to nearly all 300,000 refugee families. Brian Tachibana, a volunteer with EWB, ran into resistance when he first visited Khartoum last September to find manufacturers. Presented with a gleaming prototype that had been made in Berkeley, local craftsmen declared firmly. "There's no way you can build this in Sudan." Tachibana needed to tweak the production method—substituting hand shears for high-pressure water jets, for example—to arrive at a workable, low-tech solution.

Gadgil and EWB have yet to settle on a distribution plan. They won't be handing the stoves out as charity—"Giving something away turns the recipients into beggars," Gadgil says—but at \$25 apiece, the devices are out of the reach of most families. Gadgil favors some sort of leasing plan, allowing families to rent the stove for about 50 cents a week. The ultimate goal is for the refugees to take over the program, from manufacturing to distribution, which would mean jobs and income. Gadgil's team has already donated a range of scientific equipment, including electronic scales and anemometers to measure wind speed, in order to monitor the existing stoves and test the efficiency of alternatives. "We don't want to claim that this is the final word," Gadgil says. "If somebody comes along tomorrow or next year and says we've got a better stove, all success to them. We're trying to solve a problem here."

Darfur Cookstoves



FUEL FOR THOUGHT: Using the stove on site, Gadgil

Gathering firewood in Darfur can mean a seven-hour round trip, during which women risk attack.

Real vs. Perceived Problem: Darfur



Perceived Problem Statement:

“Design a screw press for Darfurians to turn garbage into biofuel pellets ”

Real Problem Statement:

“Redesign the cooking stove to obtain higher temperatures and make it more fuel efficient.”



“Sometimes I think we want this more than he does.”



"...so the Marketing Department suggested
I try a slide presentation."





FRAME GAMES



ISLAND **iiiiT**



**THE
CUSTOMER**



+ POWER UU



₂ LATE LATE

FRAME GAMES

ANSWERS:

- 1. Long Island Iced Tea**
- 2. The Customer Is Always Right**
- 3. More Power To You**
- 4. Too Little Too Late**

Dam the Torpedo or Torpedo the Dam?

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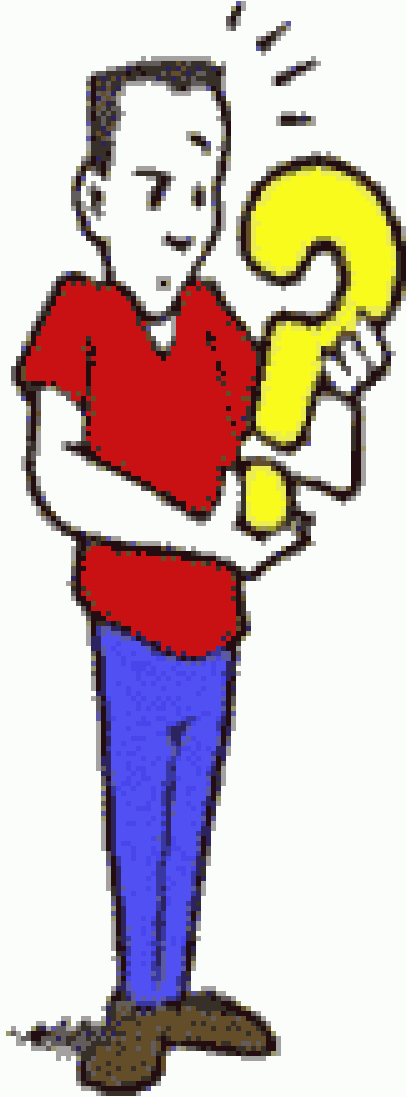
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What's the Problem?





wiseGEEK