

DEVELOPING ENGINEERING  
PROFESSIONALISM:  
*YOU GOT THE GIG NOW MAKE SURE YOU  
HAVE THE CHOPS!*

Mark J McCready  
July 20, 2016

# TOPIC TODAY....

- Synopsis of a series of lectures that are planned for CBE 31358 for Spring 2017.
- This is test run.
- Goal is to provide useful, (differentiating) insights that don't come from anywhere else in our curriculum or even in your internships.
- You are still developing as a person
  - Many “revelations” are yet to come!
- If you are interested, here is my modest contribution.

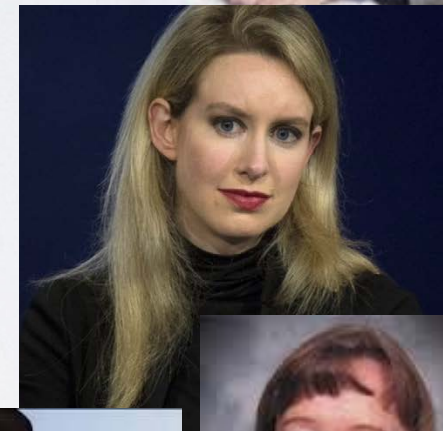
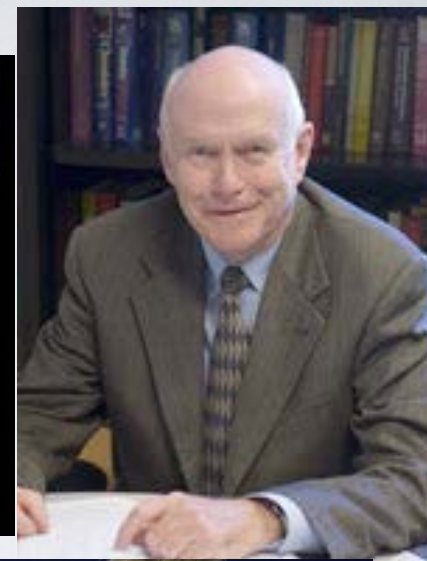
# OBSERVATIONS....THAT DIDN'T MAKE THE CUT

- “change” is like sawdust..
  - I use electronic payment!
- London is an edgier city than LA
  - I have proof.
- You can't make money a molecule at a time
  - ... apparently Boston Scientific can!
- Chemical Engineers see both the forest and the trees.
- Timing is everything...
  - a good idea now is better than a great idea in an hour!





# THE "GUESTS" (FOR THIS TALK)



# PREMISE

- The day you are hired you are not worth what they pay you.
- Only by the best efforts of the genius, rock star, CEO ( who by definition is worth every penny of the \$15 mil she/he is paid!), that the company that the company can afford you.
- However, they are not going to promote you to the next job if you are not worth it.
- I am trying to help you get there (sooner)!



# CONTEXT

- A memorable quote from my past:
  - “The more that you know, the better engineer you will be!”
- You can bring everything about yourself to your job...
- and you might need it all!



Hans Haug, formerly of DuPont

# DEVELOP PERSONAL IDENTITY

- "...Mr. Herseth, you are the greatest orchestral trumpet player in the world, you could make a lot of money from students. Why don't you?"
- He (probably never) said: "... I don't want to pick up bad habits!"



Adolf (Bud) Herseth  
Former Principal Trumpet  
of the Chicago Symphony  
Orchestra



# (ALTERNATE APPROACH)

- Do what people in authority tell you to do!



Bull Meechum  
a.k.a. Robert Duvall



# SENSE OF SELF: THE START

- Honesty, integrity, reliability, really are noble traits...
- Embrace them!

## Volkswagen to Pay Up to \$14.7 Billion to Settle Diesel-Emissions Claims

The settlement comprises vehicle buybacks or fixes



Volkswagen has settled emissions claims with regulators and owners of about a half million diesel-powered vehicles. The settlement terms were announced Tuesday by environmental regulators. The WSJ's Lee Hawkins explains.



# KEY POINT OF “SELF”

- Always have a “mirror” handy!
  - In any situation of conflict, first ask: Could I have done something differently? Should I have been better prepared? Is the result my responsibility?



# COROLLARIES TO HANS HAUG QUOTE...

- The more that you know, the smarter you will appear!
- The more that you know about the topic of the moment, the less you will have to figure out on the fly!
  - ...say on an exam!



# MAXIMIZE YOUR (EFFECTIVE) INTELLECT

- Perhaps you notice when you talk with faculty about a subject, that they have and encourage you to seek, a deeper, more focused, etc., view of the subject.
- Two cooperative effects are at play.
  - 1. We have a lot more overall knowledge of the subject and related issues than you do.
  - 2. We have “practiced” digging into a concept and really trying to appreciate all that it entails.
    - actually to the point of doing this with everything that we encounter
- Thus, when we encounter an idea that is new to us, we immediately consider how it fits with what we do know and then try to think through all of the big and small consequences.



# MAXIMIZING INTELLECT

- Read... lots... across science and technology but society as well
- Chemical engineering has numerous (but countable) profound “results” in every one of our core subjects. Go back to these and “make a career” of one for an hour or so!
  - example: Carnot cycle
    - “heat” to work
      - how exactly is this occurring?
      - why is the efficiency a function of the temperatures?
      - could you build the cycle and actually use it for anything?
- These will probably work best after you are done with the class but going back and doing this will provide the benefit of understanding more than just the specific topic.

# PARTIAL “LIST”

- Residence time... then compared to another important time scale (there must be one)
- The magic of “4” in a transient process.
- Optimization as a tradeoff between operating and capital costs
- Any of the heat— work cycles —- how is it that heat can be converted to work?
- Diesel versus Otto cycle: Is there an inherent efficiency difference?
- Entropy: Why does heat go from hot to cold?
- The pressure drop —flow rate relation for laminar flow, 4th power in R (huh!)



# GENERIC “TOOLS”

- Address any unknown by considering what happens in the limits.
- For any question in the middle of a problem, go back to the overall question.
  - Say, we need to make a profit, what scenario enables this... now, how does the set of objectives for saving on raw materials impact this.
- $\$/\text{yr} = \$/\text{kg} * \text{kg}/\text{yr} = \$/\text{kg} * \rho V k$

# RANDOM (SELF-SERVING) COMMENT

- If somebody thinks something is funny...
  - It might really be
  - e.g., “killer rabbit”



# EVERYTHING THAT WE **KNOW** IS NOT CORRECT!

- Some things we thought we knew:
  - Margarine was considered a health food
  - Stomach Ulcers are caused by stress
  - Plants absorb CO<sub>2</sub> and emit O<sub>2</sub>
  - The adult brain has no capacity to regenerate itself
  - Komodo Dragons bit their prey and waited for them to succumb to bacterial infections
  - Female Primates (Humans also?) were supposed to be born with all of the eggs they would ever produce

# MUCH OF WHAT IS BEING PUBLISHED IS PROBABLY NOT CORRECT!

Essay

## Why Most Published Research Findings Are False

John P.A. Ioannidis

Over half of psychology studies fail reproducibility test

Largest replication study to date casts doubt on many published positive results.

Monya Baker

ESSAY

## Why Most Clinical Research Is Not Useful

John P. A. Ioannidis<sup>1,2\*</sup>

## Studies show only 10% of published science articles are reproducible. What is happening?

Posted on [May 3, 2012](#) by [Moshe Pritsker](#)

Studies show a very low reproducibility for articles published in scientific journals, often as low as 10-30%. Here is a partial list:





# PAST, PRESENT AND NOW FUTURE! (HUH?)

A study of about 28,000 expert geopolitical predictions over 20 years found that most were only slightly better than chance, especially when predicting events more than a year off, according to Philip Tetlock, a professor at University of Pennsylvania's Wharton School of Business who studies forecasting.



- Yes, predictions are hard, particularly about the future!

“If you can't make an accurate forecast, who do you hold accountable for results? It bedevils managers and investors,” says Eric Ries, a management consultant who helps startups and established firms like [General Electric Co.](#) navigate uncertainty.

- Some people place the ability to assign blame as paramount in an organization!

## THE WALL STREET JOURNAL.

BUSINESS | MANAGEMENT | MANAGEMENT & CAREERS

### In Uncertain Times, CEOs Lose Faith in Forecasts

From Brexit to rise of Donald Trump, business leaders say recent events have made them wary of expert predictions

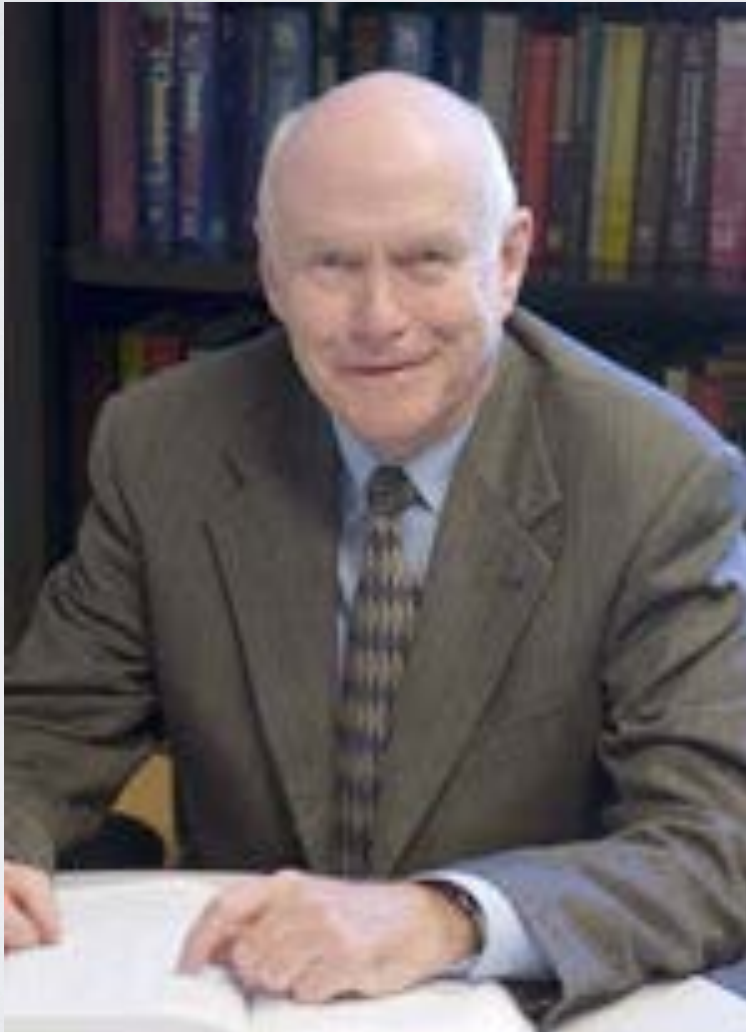
# GENERATE IDEAS

- First key is that you need to know as much as possible the subject, process, system that you are responsible for or involved in
- You need to develop a way that works for you to create new ideas.
  - I like to know how different kinds of people think.
  - I always look for connections between something that I know and something else that is the technical field of interest.
  - I also look at research/technology and specifically at what the innovations were/are.
- Even simple ideas can have significant impact





“YOU HAVE TO KNOW WHAT  
PROBLEM YOU ARE SOLVING!”



T.W. Fraser Russell  
Allan P. Colburn Professor of  
Chemical Engineering  
University of Delaware

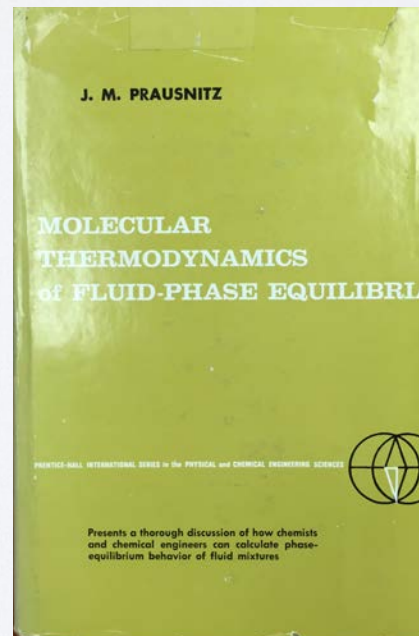
# IDEAS

... In fact, one of the outstanding characteristics of great contributors to modern science has been their ability to distinguish between what is essential from what is incidental) ..."

From: Molecular Thermodynamics of Fluid Phase Equilibria

## 6.1 The Ideal Solution

The history of modern science has shown repeatedly that a quantitative description of nature can often be achieved most successfully by first idealizing natural phenomena, i.e., by setting up a simplified model, either physical or mathematical, which crudely describes the essential behavior while neglecting details. ((In fact, one of the outstanding characteristics of great contributors to modern science has been their ability to distinguish between what is essential and what is incidental.)) The behavior of nature is then related to the idealized model by various correction terms which can be interpreted physically and which sometimes can be related quantitatively to those details in nature which were neglected in the process of idealization.



- John M. Prausnitz
- Professor of Chemical Engineering UC Berkeley
- An "academic uncle of mjm"



# “HAVE A TAKE....”



- On both societal issues and the important questions for your company, develop a well thought-out position that you can explain to others.
  - On societal issues this makes you, if nothing else.. an “interesting person”
    - Whatever you do, don’t repeat “talking points” from other people!
- If you observe that in discussions everyone is coming from the same point of view, express the counter.
  - “group-think” and “echo chambers” really are not a good way for organizations to make decisions.
  - Plus, there is a satisfying intellectual challenge to be able to express the counter point, particularly if it is not the position you would be inclined to back!
- It is also extremely valuable to be the one person in the room who can articulate a path to success in the face of significant difficulty.

# OWN IT!

- Whatever you “produce” or advise or direct, take (personal) responsibility
  - know everything possible about it!
- This includes the “process” and the people who go with it.
- If change is needed, seek to make this as efficient and painless as possible.
  - (from your ideas, what alternatives exist for all/any of the functions and tasks?)
- While you need to look out for your unit if there competition for resources with other units, it is never a good idea to go back to the “source” “whining” for more funding.
  - Make sure that you prioritize your funding to match your mission and optimize all tasks before seeking additional funding.



“You need to take care of your peeps”

Bill Witsken  
Local businessman





# COMMUNICATION

- In writing or speaking:
  - Get to the point!
- You wish to be “nice”, but also be focused and respectful of other people’s time!
- You may need to practice you skills for crafting a persuasive case — good to have the facts on your side but also need clarity.
  - I have always thought if I could make a really good case, this suggested action would be the one selected by the group (or “boss”).
- Even better if you can do this extemporaneously in conversation or at meetings.
- If you can’t do this, you may come across as “evasive” which might be admirable for a politician but is not acceptable for an engineer.



**James N. Tilton DuPont, UD**



# NOT AN ENGINEER.... FOR SURE!

"As a law professor, I don't think I've ever read an unambiguous statute," he said. "That's just the limits of human language. All policy requires some ambiguity and some discretion. If a person feels as though a law-enforcement officer has violated their First Amendment right, I suppose they can go to court, but we try to keep things from escalating to that level."

- Sorry, but no!

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ADMINISTRATION [f](#) [t](#) [e](#) [p](#)

## In a Time of Tension, Universities Craft New Free-Speech Policies

By *Arielle Martinez* | JULY 12, 2016

# OTHER INTERPERSONAL SKILLS

- email: In many organizations, this is the main mode of communication. You will need to become good at efficient writing that makes exactly the point you want.
  - A particular challenge is to arrange wording such that a contentious issue can be discussed without causing personal ire or uncomfortableness.
- You have to accept that this is time-consuming. But the value is that you have a chance, perhaps at your best timing, to express exactly what you want to say.



# YOUR PERSONALITY

- You might hear the universal advice...
  - Be yourself!
- No, sorry.. “Oh you must be kidding!”
  - Be an energetic, positive, interesting person
  - When something happens: “get over it!”



# PERSONALITY

- Be a good friend, cultivate friends
  - But don't expect friends to do anything illegal, unethical, inconsistent with the rules of the company.
  - Often you just need to listen (in confidence) any agreeing could be great, but you might need to sometimes say:
    - "I hear what you are saying and I understand, but I wonder if it is possible that "X" is not 100% wrong?"
- When you get a chance, do someone a favor...
  - it feels good.... even if they never know!



# EMPATHY

- If you are a supervisor you need to be impartial in your evaluations and follow the standard practices of your company.
  - But people will appreciate you more and perform better for you if you “care” and at least let hints of this be known.
- There is some standard hogwash about male v. female “bosses” and that women are viewed differently than men.... (see above!)
- If you have “difficult” employees.... they will be difficult,
  - (Much more information about supervising people is available elsewhere.)
- Everyone likes praise!
- You are not “better” or more important than the hourly workers!

# SELF AWARENESS COMPARED TO OTHERS

- Cr number
  - ratio of how smart you are to how smart you think you are
- Ch number
  - ratio of how smart you are to how smart you would have to be for us to put up with you
- “TO” number:
  - Ratio of how good you are to how good you would have to be for us to keep you on the team!
    - Don't be high maintenance!



# ROLE MODELS

- My background is such that I never needed to see an example of what I wanted to do to prove I could do it.
- However I always considered that various traits or views of other people could be useful to consider adopting.

# SUMMARY



- Make yourself into a better *person*... pick good characteristics.
- Take responsibility for your “gig”!
- Maximize your intellectual prowess.
  - Learn as much as possible.
  - Try the mjm exercises on core ChEg ideas.
- Generate ideas and be able to effectively express them orally and in written form.
  - “Trust me”... we don't know everything!
- By observing others, (and reflecting) learn how to effectively relate to coworkers, bosses and subordinates





# ***DIMENSIONLESS*** CHINESE PROVERB

$$Cr \equiv \frac{\textit{How Smart You Are}}{\textit{How Smart You Think You Are}}$$

- He who knows not and knows he knows not is a child, teach him,  $Cr \sim 1$
- He who knows not and knows not he knows not is a fool, shun him,  $Cr \ll 1$
- He who knows and knows not he knows is asleep, awaken him,  $Cr \gg 1$
- He who knows and knows he knows is wise, follow him  $Cr \sim 1$