Lessons Learned from the Front Lines

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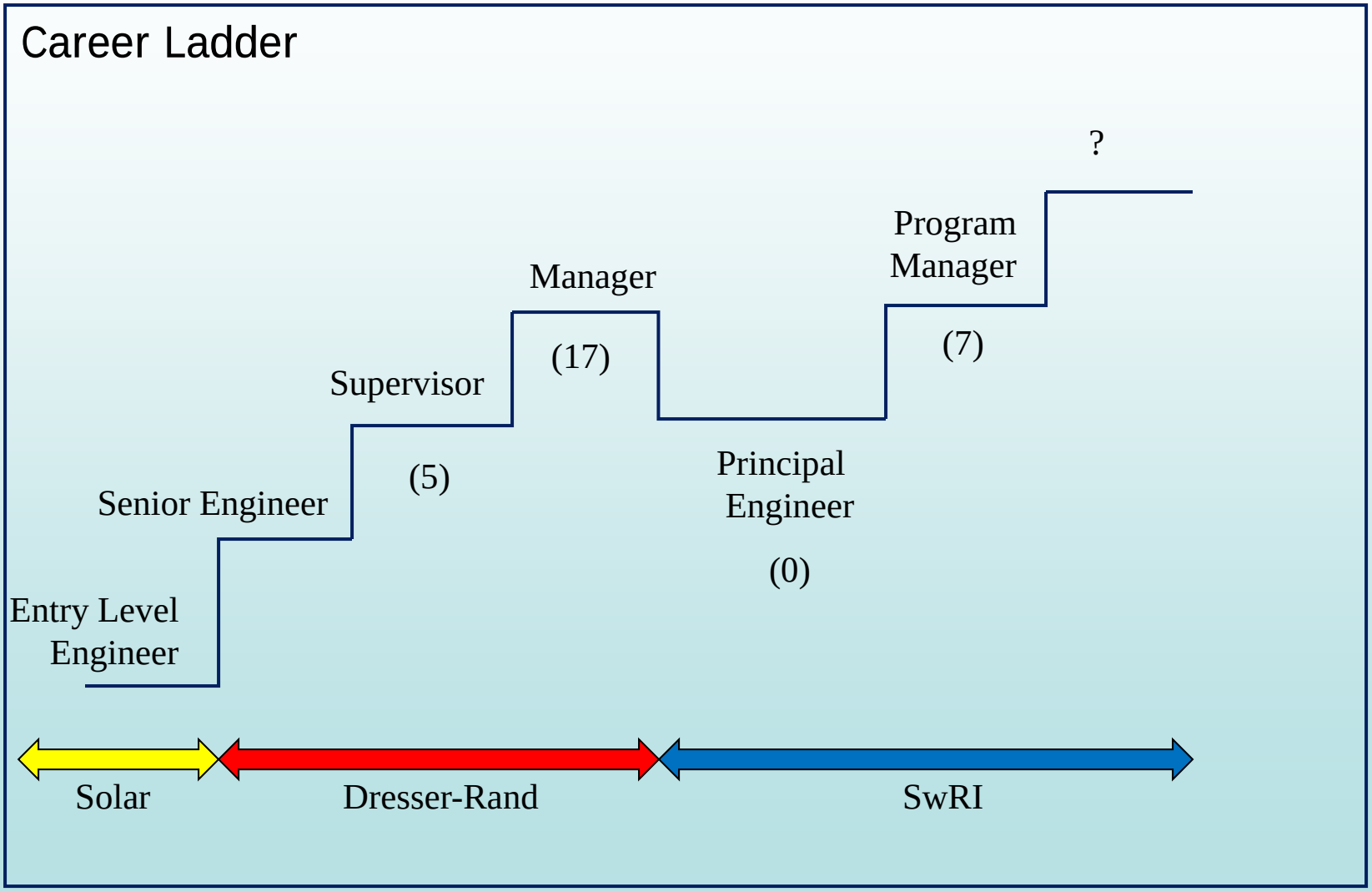
A Little about Me…

- Graduated High School in Rockwall Texas
- Worked in my father's engineering company in high school
- Learned to work on cars and motorcycles working with my dad and brother
- Got my pilot's license when I was 17
- Got my BS in ME from TAMU in 1991 followed by my MS in 1993
  - Studied impact dampers for rocket engine turbopumps
- Went to work for Solar Turbines in San Diego
  - Industrial gas turbine and centrifugal compressor manufacturer
- Returned to TAMU for my Ph.D. in 1996 working under Dr. Palazzolo
  - Studied rotor/fluid interaction forces around seals and impellers using CFD methods

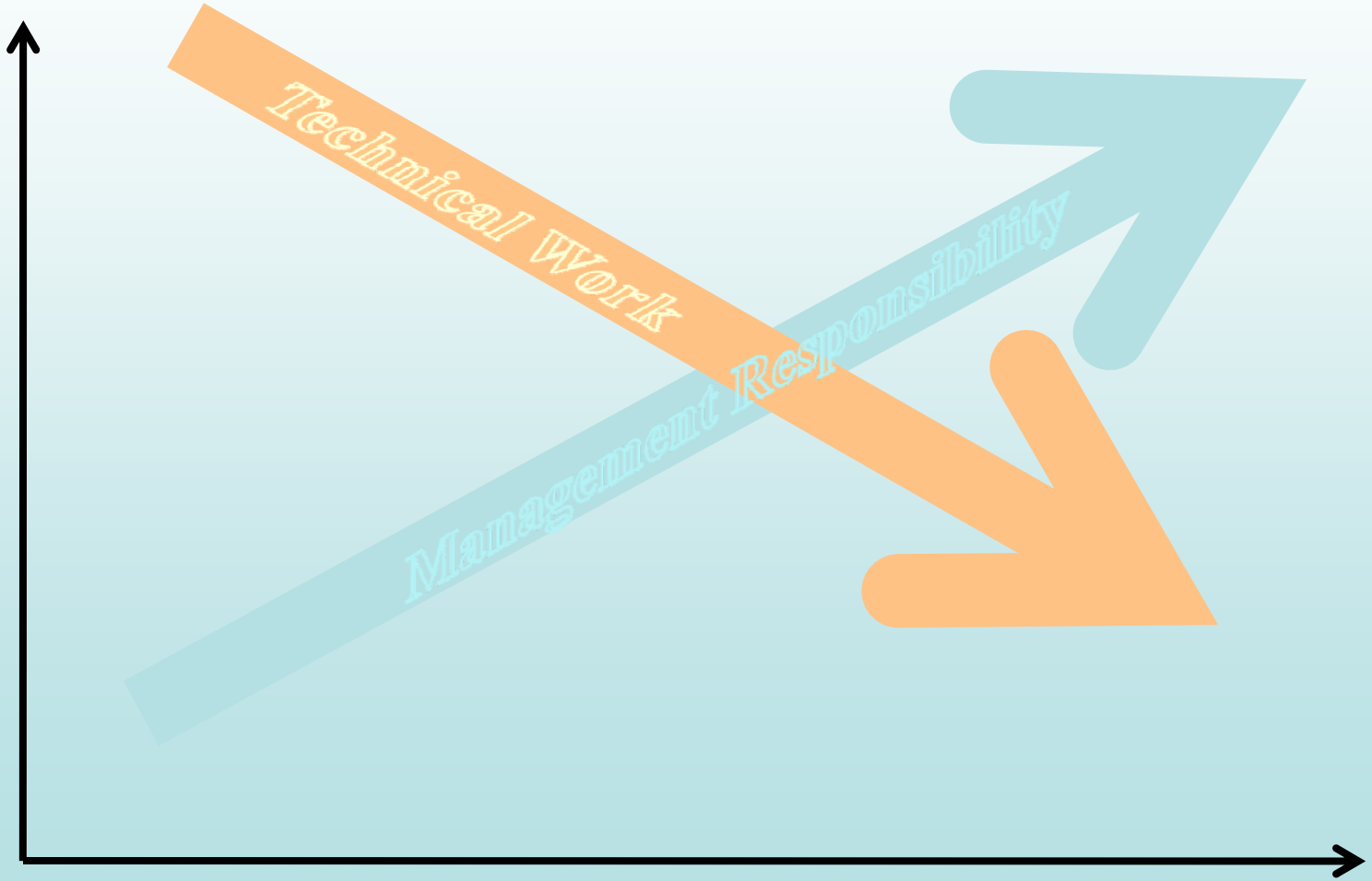
A Little More about me…

- Joined Dresser-Rand, manufacturer of large centrifugal compressors, expanders, steam turbines, and reciprocating compressors
  - Started as an aerodynamics engineer
  - Became the supervisor of rotordynamics
  - Later managed the development engineering group
  - Applied damper seal and swirl brake technology, magnetic bearings
  - Led the development of a 12,000 psi centrifugal compressor
  - Led development of a 12000 hp, 12000 rpm integrated motor/compressor on magnetic bearings
  - Demonstrated that a compressor can be designed that gets more stable with increasing pressure
- Joined Southwest Research Institute in 2004
  - Principal Engineer
  - Program Manager

More about me….

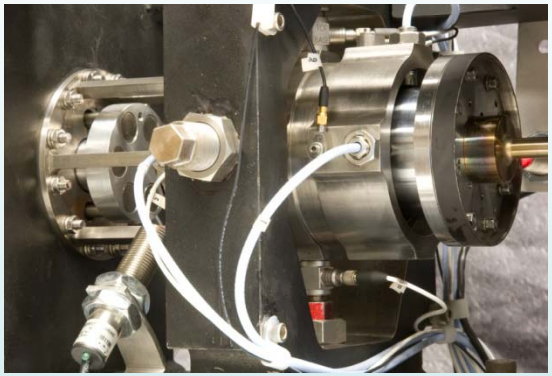


Don't be in a hurry to go into management



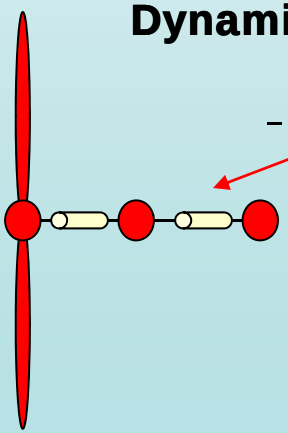
Test Rig Development:

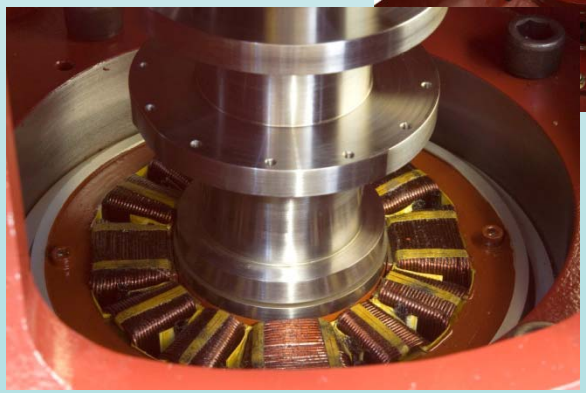
60,000 rpm Air Bearing Test Rig



30,000 rpm Magnetic Bearing
Subsea Compressor Simulator

Wind Turbine Dynamics:

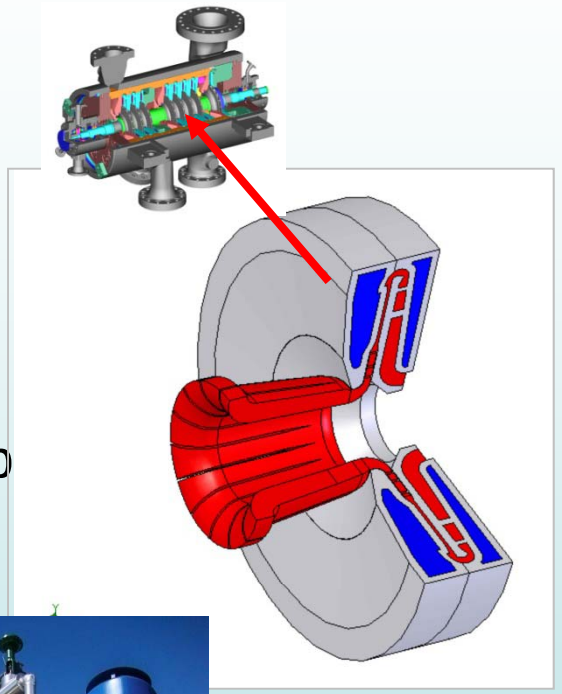




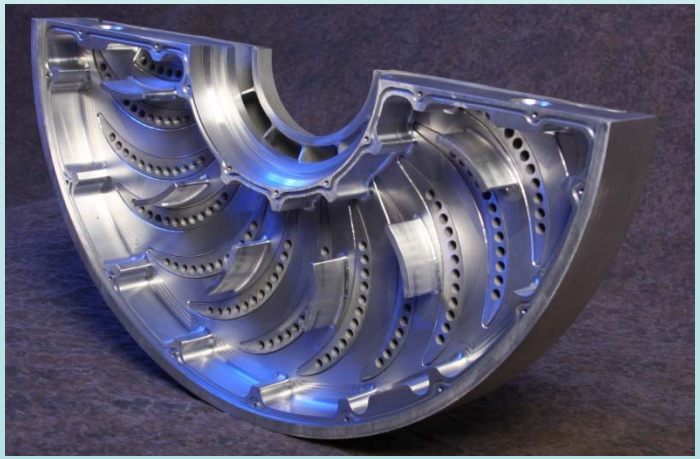
More Cool Projects

CO2 Compression and Pumping Research

- DOE funded project to develop advanced compression technologies
- Internally cooled compressor diaphragm developed and tested
- Project is also testing liquefied CO_2 turbopump



Cooled Compressor Diaphragm



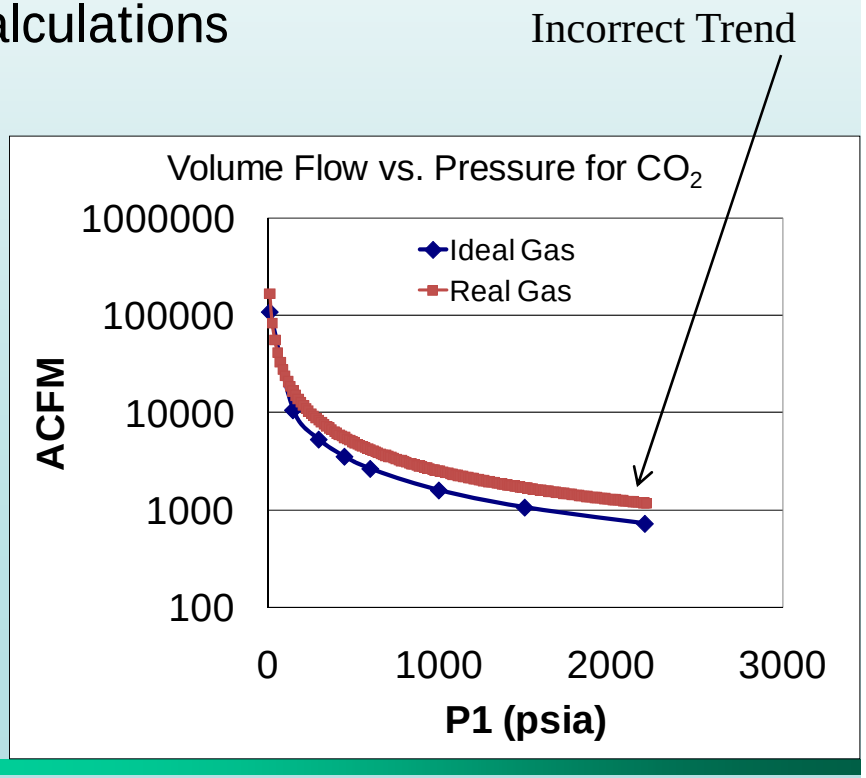
Liquid CO_2 Pump Loop

Pointers

- Early hand's on experiences have served me
- Knowledge of design for manufacturing important
- Writing and presentation skills are key
- Never stop learning (Dr. Tony Smalley)
- Give yourself marketable skills in school to differentiate yourself
  - Finite element analysis
  - CFD Analysis
  - Solid modeling
  - Data acquisition and programming
- Pay your dues...don't move into management too soon
- Keep your technical edge (perform hand calculations, attend conferences, keep up with software advances)
- Develop project manage skills

Be an independent thinker

- Don't be too quick to join the consensus
- Are laws of physics being violated
  - 1st and 2nd law of thermo
  - Strength or temperature limits of materials
- Verify computer results with hand calculations
- Do the trends make sense?
- Examples:
  - Cold fusion
  - A coupling with efficiency > 100%
  - Novel power cycles

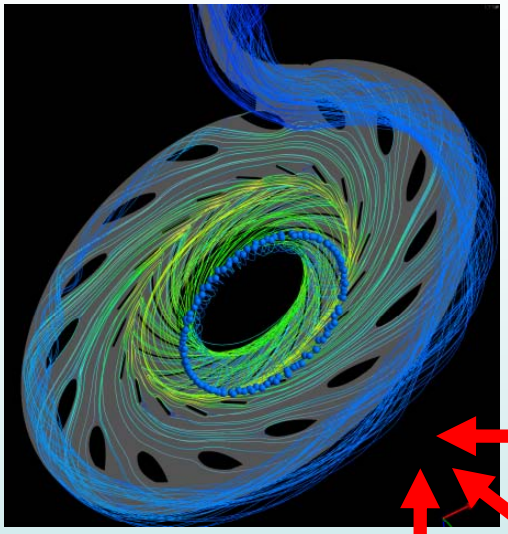


Design work

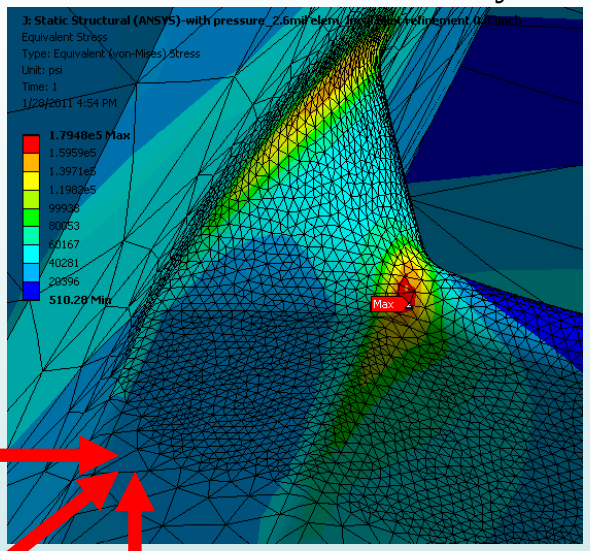
- Identify technology gaps and if research will be required to close them
  - Material requirements
  - Operating limits (speed, stress, pressure, temperature, etc.)
- Develop a clear and concise design space (conceptual design)
  - Lead to set of functional requirements
  - Perform PDR
- Develop an “80% Design” in initial detail design phase
  - No substitute for experience
  - Use computer analysis to bring into a 100% design (multi-physics)
  - Perform CDR to determine that detail design satisfies cost, schedule, and performance requirements
  - All designs are a compromise between competing constraints
- Testing
  - Virtual test rig???
  - Use to verify predictions and that functional requirements are met
  - Perform uncertainty analysis
- Cost optimization and design for manufacturing
  - Statistical process control (e.g. 6-sigma)

Turbomachinery Concurrent Design

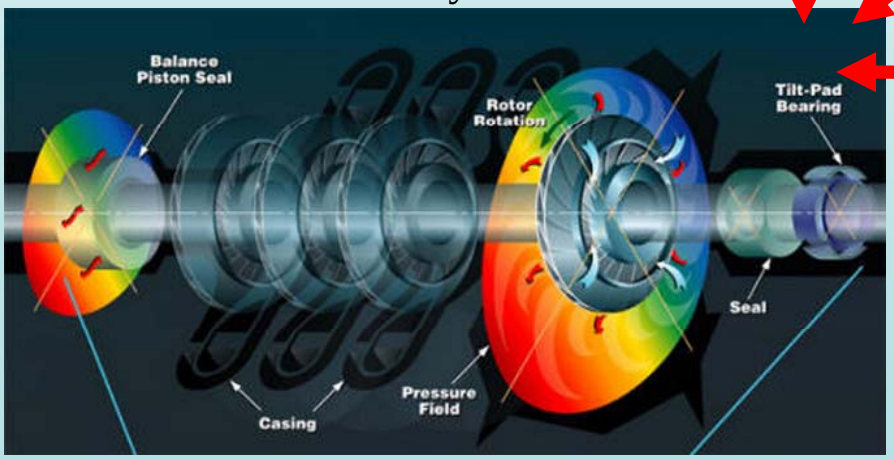
Aero Design



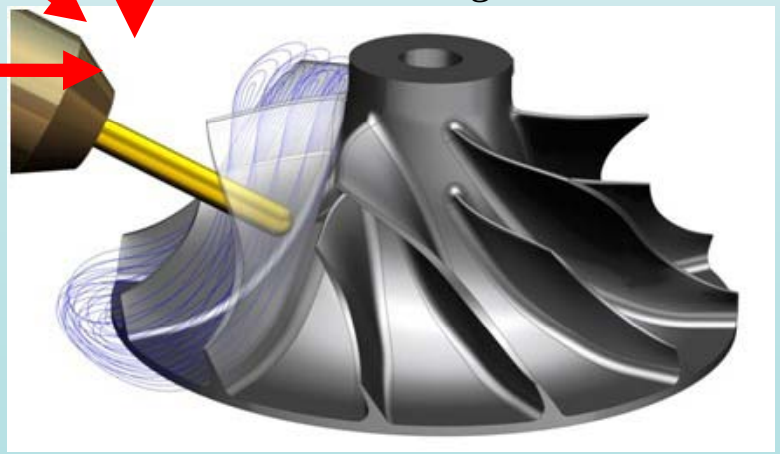
Stress Analysis



Rotordynamics



Manufacturing



Tips to landing a job

- Develop relationships with managers and engineers inside companies
  - Conferences
  - Professional societies
  - Consortia (e.g. TRC)
- Internships
  - Preferably 6 months
  - Even on graduate level
- Dress code on interview
  - Business casual becoming more accepted
  - Better to over-dress than under-dress
- Ask to make a presentation at the company when intervie
  - Demonstrates verbal and presentation skills
- Be confident, but not cocky
- Make good eye contact, be friendly but respectful ("yes sirs, yes ma'am"
- Do your research on the company
- Be prepared to ask intelligent questions about the company, their products, markets, etc. and how your skills will help them meet those goals
- Do **not** work 2 companies against one another to create a bidding war

David's Career

- B.S. Engineering Technology (1995) Huslin'1, Corps of Cadets
- M.S. Mechanical Engineering (1997) Advisor: Dr. San Andres
- The real world...
  - Rocketdyne – SSME, RS-68, others, seals, bearings, rotordynamics
  - Turbocare – Repair of industrial machinery, steam turbines, compressors, pumps, seals, bearings, rotordynamics
  - Boeing – Shuttle Program, structural dynamics
    - Started P.E. application
  - SwRI – mix of both energy and aerospace industries
    - Completed P.E. application

Rocketdyne

Member of Technical Staff

Turbocare

Staff Engineer

Manager

Boeing

Engineer

Senior Research Engineer

SwRI

Principal Engineer

Program Manager

Project Management (we are all project managers at some level)

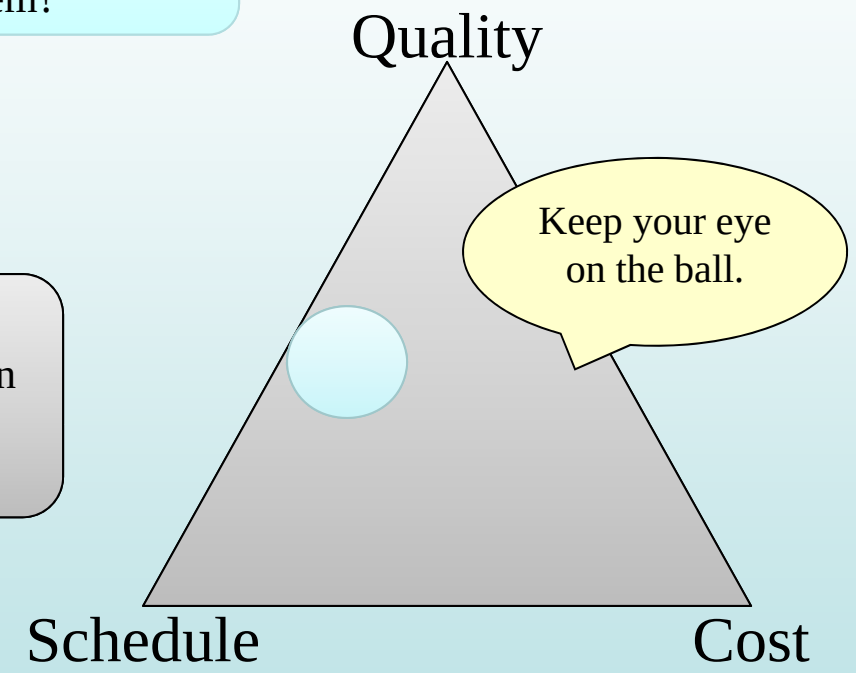
Know your clients (internal and external). What do they really need, and what is most important to them?

Manage client expectations. Schedule slip is in the eye of the beholder.

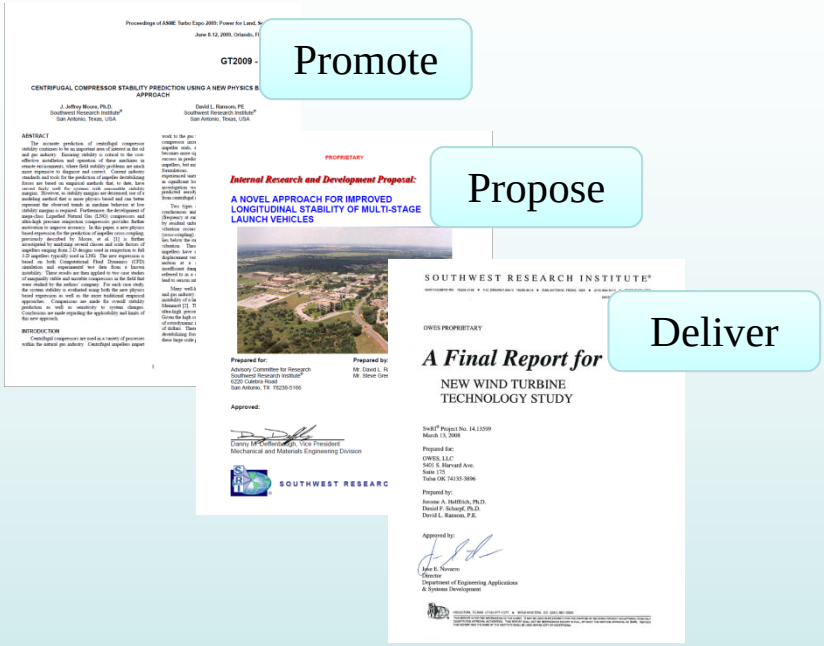
Communication is Critical. Listening is an important part of communication.

KISS

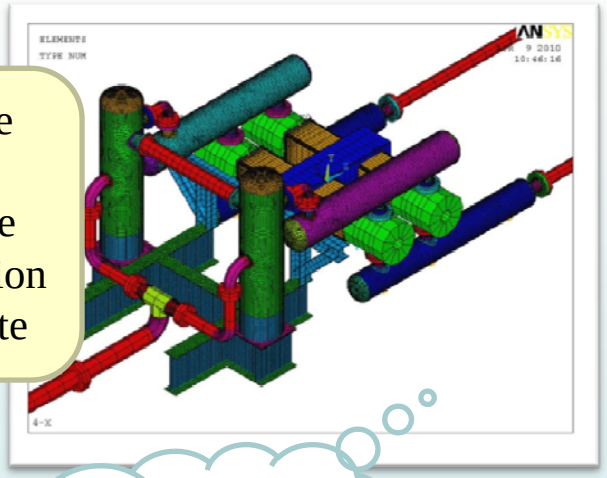
The answer is always "Yes", followed by "Here is what it will take to get it done…"



More Critical Engineering Skills

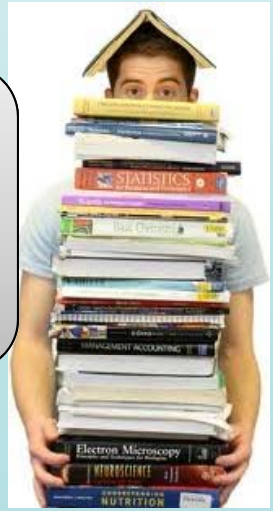


Know the answer before the CAE solution is complete



"How can I verify these results?"

Don't stop studying after you graduate. Be curious, ask questions.



International Skills

International technical language is English, but…

- Slow down
- Get feedback
- Written follow up

Get comfortable with SI and English units