

Green Pastures —
A Fresh Look
at Traditional and Non-Traditional
Career Opportunities
for Chemical and Biomolecular Engineers

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Chem Show 2019 ~ Keynote Speech ~ Career Day Event

Sponsored by AIChE NYC-Metro (24October2019)

Introduction and key takeaways

- The scope of career opportunities in chemical and biomolecular engineering continues to evolve
- Graduates in these two ***dynamic and flexible fields*** are able to pursue ***intellectually satisfying*** and **lucrative** career opportunities... in ***a wider-than-ever array...*** of both ***traditional and non-traditional*** industry sectors, technical and non-technical career tracks, and geographic locations
- Their ***unique training*** and ***problem-solving capabilities*** makes them highly sought-after... and today's ***salaries*** for chemical engineers and biomolecular engineers are ***among the highest*** in the engineering profession
- Many ***satisfying career options and pathways are available*** ... and not only for recent graduates, but for working engineers who are bored or burned out in their current company/industry, or feel pigeonholed in terms of forward career momentum, as well

What I will discuss:

1. Some of the trends that are creating strong career opportunities for today's chemical engineers and biomolecular engineers, and recent salary and hiring data

2. Some best practices and wisdom shared by our 25 profiled engineers

3. A few additional job-search tips and recommendations from my personal experience

4. Two quick stories and wrap-up

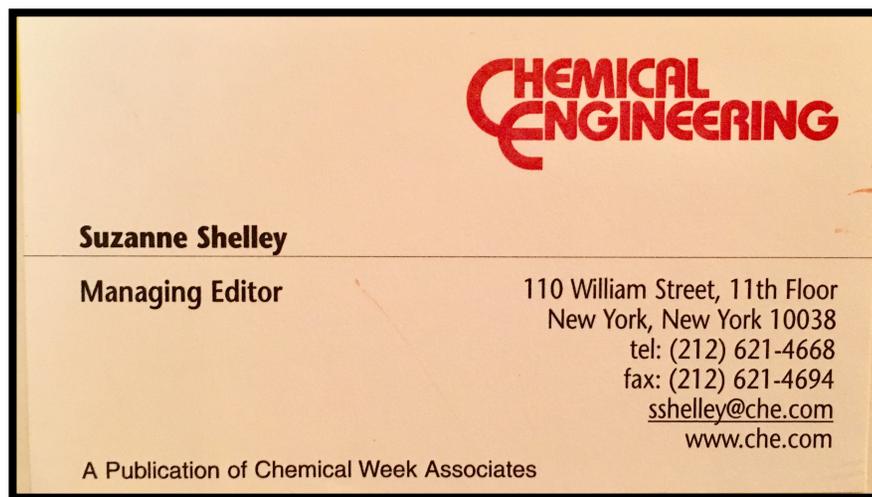
About me — *Unanticipated career pathways*

- *Two degrees in Geology*
 - Colgate University (B.S.), University of South Carolina/Columbia (M.S.)
- *Amoco Production Company, New Orleans, La.*
 - Deepwater Exploration Geologist in the Gulf of Mexico
- *Chemical Engineering* magazine, Editor (30+ years on masthead; since 1989):
 - First 17 years (1989–2005) ~ full-time Editor, incl. 5 years as the magazine's **Managing Editor** (2000–2005)
 - *During that time, I also started up and ran two sister/spinoff publications:*
 - *Environmental Engineering World*
(served as Executive Editor; 21 issues, 1992–1996)
 - *ePlant* (served as Managing Editor; 7 issues, 2000–2001)
 - Next 15+ years ~ freelance Contributing Editor (2005 to present)

*Two career highlights ~ while a full-time Editor at
Chemical Engineering magazine*

1. Proud to break barriers:

First woman (*and the first non-chemical-engineer*) **to ever be promoted to Managing Editor** of *Chemical Engineering* magazine (in 2000)
— Occurred *when the magazine was nearing its 100-year anniversary*
(*and the publication was itself older than McGraw-Hill itself*)



**CHEMICAL
ENGINEERING**

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A Publication of Chemical Week Associates

Two career highlights while a full-time Editor at Chemical Engineering magazine

2. In 2005 I was profiled among 100 women who love their careers, in this book, authored by an Editor at Forbes magazine:



In her own words

Suzanne Shelley, 39
Managing Editor
Chemical Engineering Magazine
New York, New York

Suzanne is the highest-ranking female on the editorial side and the first woman to hold the position of managing editor at this 100-year-old trade magazine. *Chemical Engineering's* readers are engineers who work in the manufacturing, pharmaceuticals, and petroleum industries, among others. A science buff before becoming a writer, Suzanne holds a bachelor of science as well as a master's degree in geology. Her duties include writing and editing articles for monthly issues, as well as managing the magazine's staff and production. She also manages a staff of editors who produce bilingual newspapers for international industry trade shows. On a side note, it's a testament to *Chemical Engineering* that several women from its editorial and sales staff applied to be part of The Happy 100. Clearly, Suzanne is not the publication's only fulfilled female worker.

Whenever my friends joke with me about my job, I tell them Chemical Engineering is the bible for some 200,000 chemical engineers. They look to the trade magazine to stay on top of the profession so they can do their jobs better. Our readers never throw an issue away, unlike more well-known business magazines.

Our editorial staff is mostly engineers; I am the token geologist. I got the job when I sent a résumé to the publisher, McGraw-Hill, and interviewed with the human resources director. He liked me but did not know what to do with me, so he told me to call him every two weeks to see if something opened up. Over time I got the feeling that he was, like, "You're still calling?" But I had to swallow my pride and keep showing up. Eventually he sent my résumé to Chemical Engineering, and I was hired

So.....
why
am
I telling
you
this?



"If someone offers you an amazing opportunity and you're not sure you can do it, say yes - then learn how to do it later."

- Richard Branson

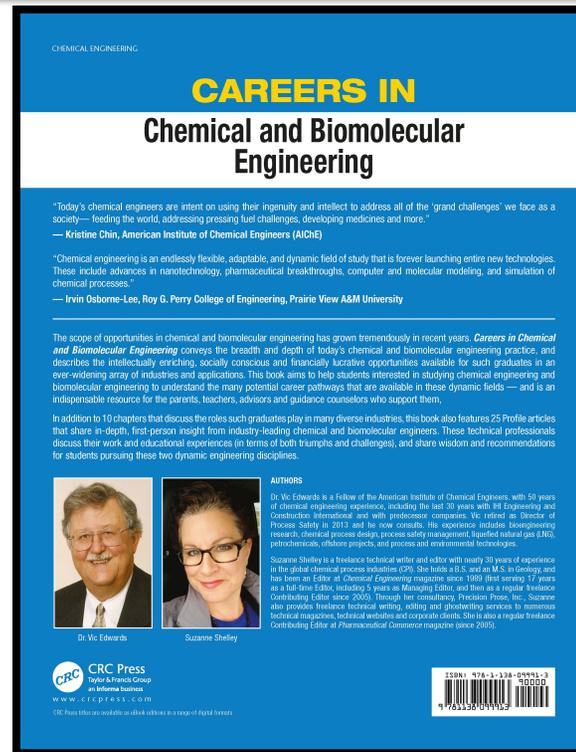
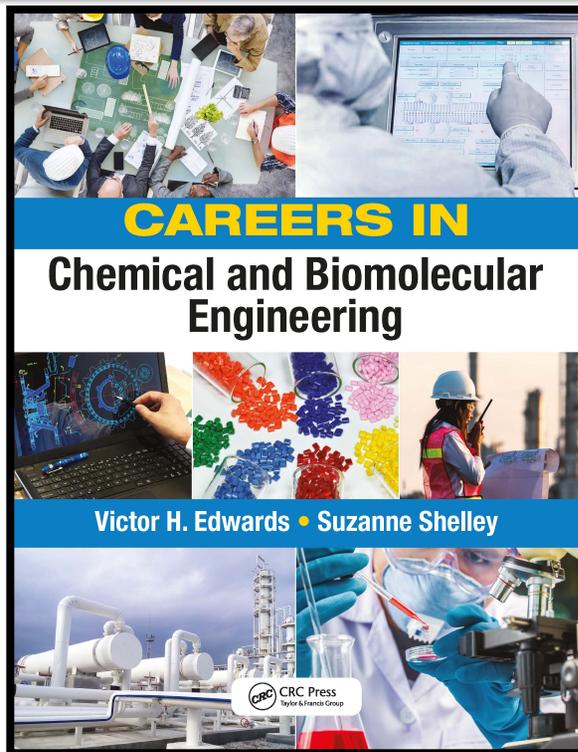
About me — More-recent career highlights

- Principal/Owner of Precision Prose, Inc. — In 2005, I launched my full-time freelance technical writing/editing/ghostwriting business (now in Year 15 as a full-time, self-employed freelancer)
- Over the past 15+ years (since going “full-time freelance”), I’ve been a regular freelance Contributing Editor at *Pharmaceutical Commerce* magazine (since 2005; **concurrent** with my ongoing role as a freelance Contributing Editor at *Chemical Engineering*)
- As a freelancer, I’ve also served as a periodic freelance Contributing Editor with two other magazine — *Chemical Engineering Progress* (CEP; AIChE) and *Turbomachinery International* (each for 7–9 years)
- **Corporate clients** — I provide freelance writing, ghostwriting and editing services to a diverse and ever-changing roster of corporate clients in pharma and chemical process industries (CPI)

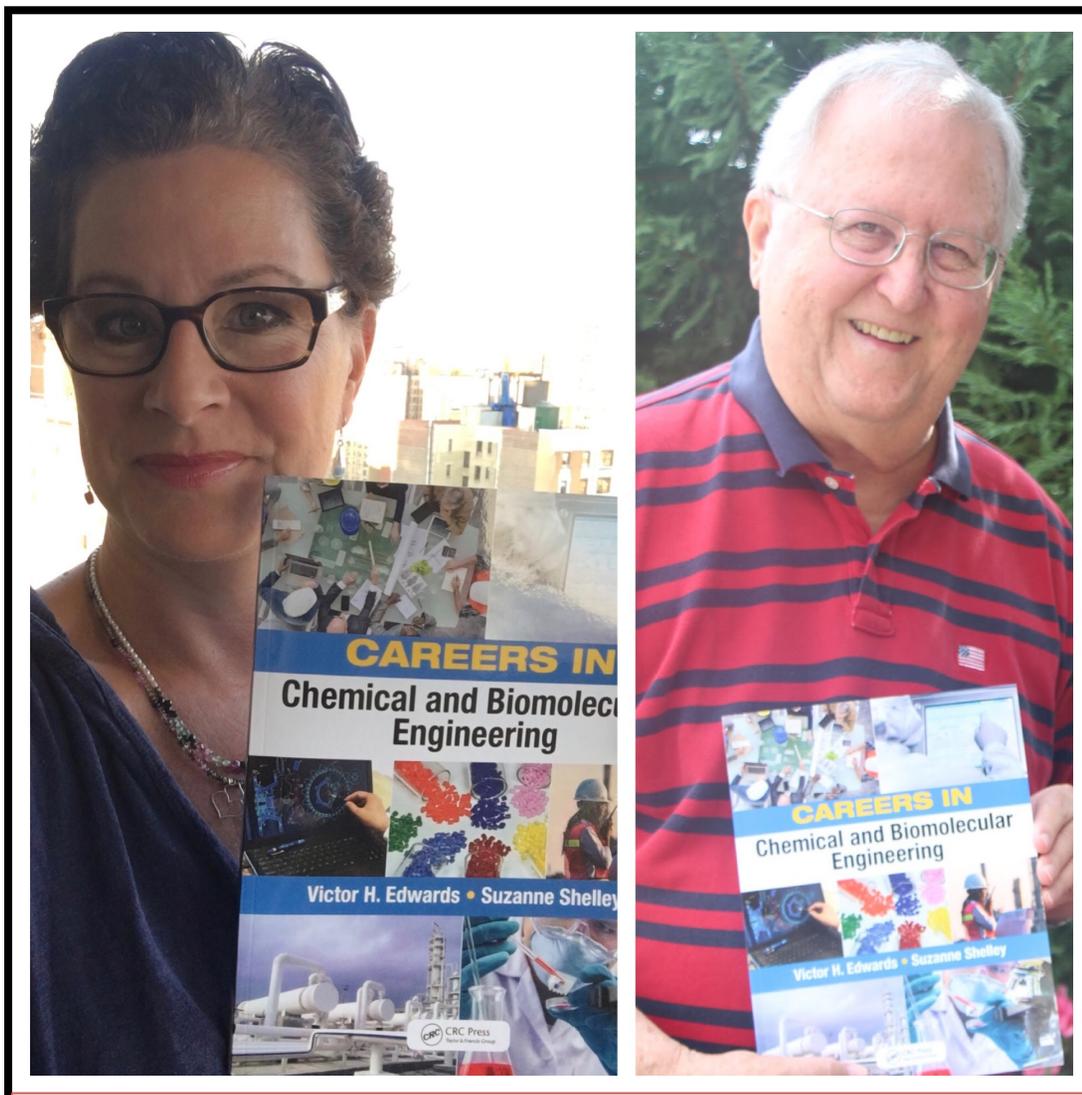
Most recent challenge accepted — Book author
~ Which leads us to today...

Vic Edwards and Suzanne Shelley, *Careers in Chemical and Biomolecular Engineering*,
CRC Press/Taylor & Francis, 2018

[https://www.crcpress.com/Careers-in-Chemical-and-Biomolecular-Engineering/
Edwards-Shelley/p/book/9781138099913](https://www.crcpress.com/Careers-in-Chemical-and-Biomolecular-Engineering/Edwards-Shelley/p/book/9781138099913)



*A labor of
love ~ first
imagined in
1990.....
Finally
pitched to
CRC Press in
2016, and
then
written and
published in
2018*



*Friends and book co-authors:
Suzanne Shelley and Vic Edwards, August 2018*

Our book contains:

- **10 Chapters** — discuss different industries in which chemical and biomolecular engineers work, and the many different roles they play, putting their expertise to work
- ***Profiles of 25 Esteemed Chemical and Biomolecular Engineers***

Their in-depth, first-person narratives candidly discuss:

- *The inherent flexibility, intellectual satisfaction and lucrative nature of their varied career choices*
- *Triumphs, challenges/failures and frustrations they've encountered along the way*
- *Wisdom and recommendations for students and young engineers who are just starting out*

Chemical engineers and biomolecular engineers — Uniquely skilled, uniquely positioned

Imagine, explore
and pursue
**promising chemical
reactions/
conversions ...** and
shepherd them
through **all stages**
from **test tube**, to
**small-scale
demonstration** to
viable, **commercial-
scale production**



What makes you so special?

Chemical engineers and biomolecular engineers are in such great demand because they bring a lot to the table:

- Unique knowledge base
- Deep intellectual rigor
- Deep understanding of — and comfort with — chemistry and/or biology, math and many aspects of engineering, materials science, safety, environmental stewardship, modeling and simulation and more
- Diverse skillsets that grow with every position, every company, every industry
- Strong problem-solving capabilities

A wise old sage (my Dad, a PhD
mechanical engineer)
always liked to say:

Science is what is....

*Engineering is what you want it
to be...*

Process design and scaleup — *what's so hard about that?*

Chemical and biomolecular engineers are uniquely qualified and well positioned to create ways to convert raw materials into finished products:

- Manage all **modeling and design issues** to support scaleup and operation
- **Select and procure** all of the **complex equipment components and systems**
- **Design and implement monitoring/process control/alarm systems**
- **Evaluate and select** the most appropriate, affordable **materials-of-construction**
- Account for all **mass balances, heat and pressure buildup, byproduct streams** at every stage of scaleup

(continues)

Process design and scaleup — *what's so hard about that?*

- Design and implement all **engineered systems** needed to manage **environmental considerations and ensure safety** (treat waste streams/ wastewater/hazardous emissions, minimize fire and explosion risk and more)
- Ensure **regulatory compliance** with state, local, federal and international regulations
- Support **business-development considerations** in both emerging and crowded/ competitive markets, including legal considerations, intellectual property issues, marketing and communications
- **Create jobs, nurture talent and mentor others, drive profitability and excellence for the company....and so much more**

Hiring and salary data* — *Remain strong*

Factors driving strong employment — and strong competition for talent — across the many industries that employ these engineers:

- Need for professionals with **highly specialized engineering skills, problem-solving capabilities and experience**
- **Large-scale retirement** of “Baby Boom” generation workers
- Large **skills gap** in many manufacturing sectors
- **Capital spending boom** is spurring demand for tech workers

* Jenkins, S., Economy and Opportunity Drive high CPI Salaries, *Chemical Engineering*, Dec. 2018; pp. 13–16.

Hiring and salary data* — *Remain strong*

The **unemployment rate** for chemical engineers remains low (roughly **1.5%**) — *and is lower than the overall unemployment rate for all fields, which was 3.7%*

— *October 2018 data, according to the U.S. Bureau of Labor Statistics (Washington, D.C.; www.bls.gov)*

* Jenkins, S., Economy and Opportunity Drive high CPI Salaries, *Chemical Engineering*, Dec. 2018; pp. 13–16.

Results from the Manufacturers' Outlook Survey, conducted by the National Association of Manufacturers (Washington, D.C.) **showed high levels of optimism among manufacturing companies**, in several sectors of the CPI

According to the survey, the “inability to attract and retain sufficient workers” remained the top concern for survey respondents — with 73% of survey takers rating this as their most pressing concern

Hiring and salary data* — *Remain strong*

*Chemical Engineering magazine — Salary survey (Oct. 2018):**

- *Average salary of respondents was \$133,600 — a 1.6% increase over findings from the prior year*
- *More than 75% of respondents earned >\$100,000/yr*
- *35% of respondents reported salaries between \$100,000 and \$140,000/yr*
- *Only 12% reported their salary was <\$80,000*

* Jenkins, S., Economy and Opportunity Drive high CPI Salaries, *Chemical Engineering*, Dec. 2018; pp. 13–16.

U.S. Bureau of Labor Statistics reported* in 2017 that average salary for all chemical engineers was \$102,160

American Institute of Chemical Engineers (AIChE) reports* the median salary for chemical engineers is \$124,000

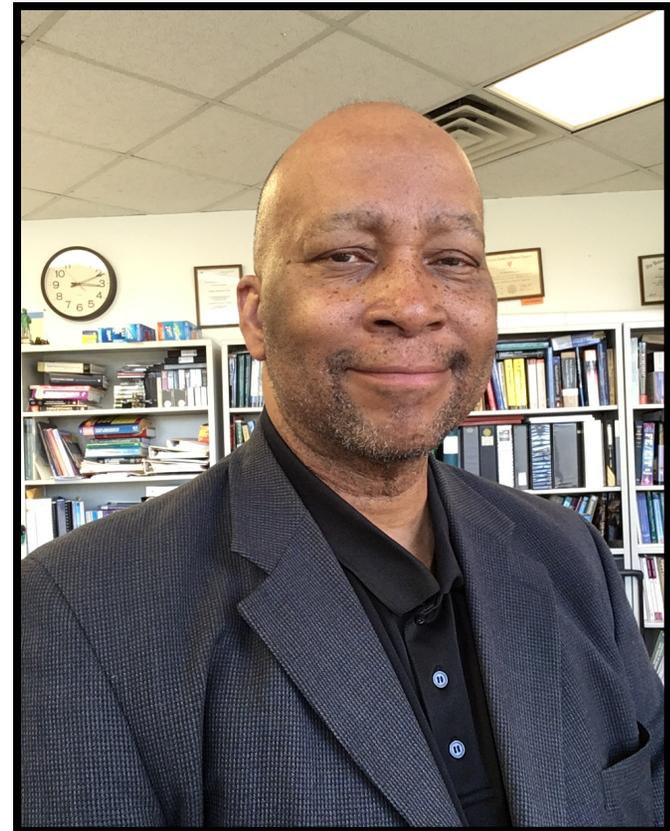
According to the Winter 2017 survey of employers from National Assn. of Colleges and Employers (NACE),** **chemical engineering graduates in the Class of 2017 earn the highest average starting salary (\$68,445) among top 10 engineering disciplines**

**<https://www.nacweb.org/job-market/compensation/top-paid-class-of-2017-engineering-bachelors-masters-grads/>

Let's hear from some working chemical and biomolecular engineers (*who were interviewed in my book*)

“Chemical engineering is an endlessly flexible, adaptable and dynamic field of study that is forever launching entire new technologies.”

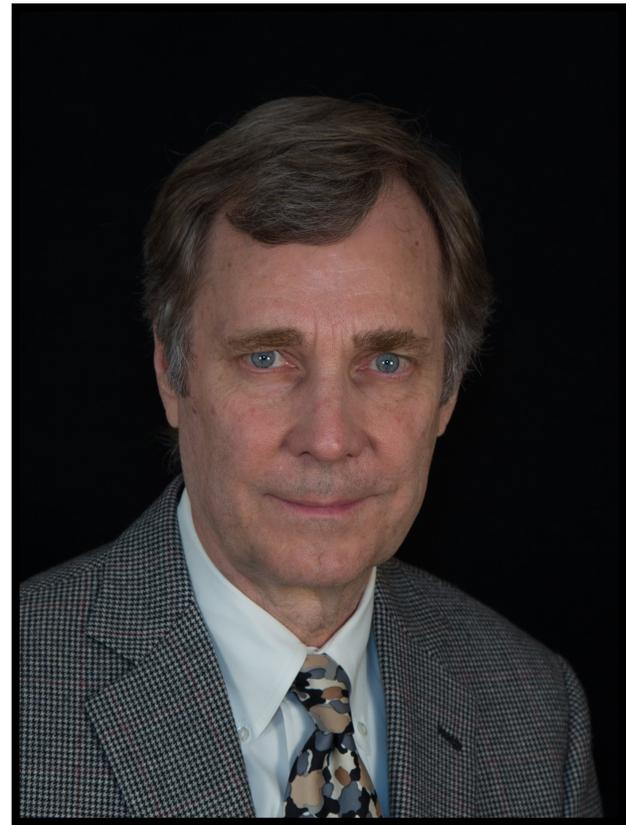
— Irvin Osborne-Lee, Head of the Department of Chemical Engineering, Prairie View A&M University (Prairie View, Tex.)



Let's hear from some working chemical and biomolecular engineers (*who were interviewed in my book*)

*“The demarcation between traditional fields is blurring, with so many chemical engineering advances that continue to be used by, and benefit many **different industry sectors.**”*

— Freeman Self, Design Engineer
and Fellow, Bechtel
(Houston, Tex.)



Let's hear from some working chemical and biomolecular engineers (*who were interviewed in my book*)

*"The field of chemical engineering is **dynamic and continues to grow....***

It continues to gobble up new, adjacent and allied fields, such as biological processes, nanotechnology, pristine processing, safety-related issues, environmental management and more —

*So the umbrella gets **bigger and bigger, providing new and interesting avenues for chemical engineers to explore.**"*

— Shrikant Dhodapkar, Research Fellow at the Dow Chemical Co. (Midland, Mich.)



Chemical engineers and biomolecular —
Tackling the **big, global challenges that affect us all**

They are uniquely trained to spearhead efforts related to:

- Clean air and clean water
- Global warming and climate change
- Food security for a growing population
- Lifesaving medications and vaccines
- Advanced materials and advanced circuitry to enable smaller, more-powerful electronic devices we all depend on
- Sustainable fuel options and energy sources (to reduce dependence on fossil fuels)

Specifically, today's chemical engineers and biomolecular engineers are finding employment in these sectors:

- *Manufacturing of all types*
- *Engineering design and construction*
- *Petroleum refining*
- *Petrochemicals and specialty chemicals production*
- *Plastics/polymers processing*
- *Advanced materials and metallurgy*
- *Food processing, production and packaging*
- *Clean energy, wind, solar, carbon sequestration and more*
- *Pulp-and-paper production*
- *Aerospace, automotive, other*
- *Electronics and microelectronics development and manufacturing*
- *Pharmaceutical/vaccine discovery and development (not only the pharma/biologic medications, but the complex drug-delivery devices and systems, lab-testing methodologies, wearable monitoring devices)*
- *Consulting, Forensic engineering, Forensic science investigations*
- *Legal services ~ contract law, intellectual property and more*
- *Academia*
- *Trade press/journalism*

On the value of finding that spark, and exploring synergies

*"I like to tell young engineers ~ You're not 'just another engineer'...
You may end up being THE engineer who really makes a difference...*

*...**This should inspire you to do more than just work your job, 9–5, and go home and live your life in an isolated way...Rather, you should find your interests and passions and get together with others who share them.**"*

— Kristine Chin, Director of Conferences,
American Institute of Chemical Engineers
(AIChE)



Process safety — Important for all, so many ways for engineers to get involved

*“A chemical engineering degree provides a **great foundation** ...that allows you to be **deeply involved in the wide-ranging principles of process safety management (PSM)** — which includes the development and implementation of management systems, procedures and tools that can help to ensure the safe handling of hazardous chemicals, the use of inherent safety principles, process hazard analysis, proper equipment design, establishing a hierarchy of controls and putting the practices and training in place to ensure system integrity.”*

— Kathy Shell, Executive Vice President, Process Safety and Lifecycle Solutions, Applied Engineering Solutions (aeSolutions)



Best career advice from the engineers profiled in our book

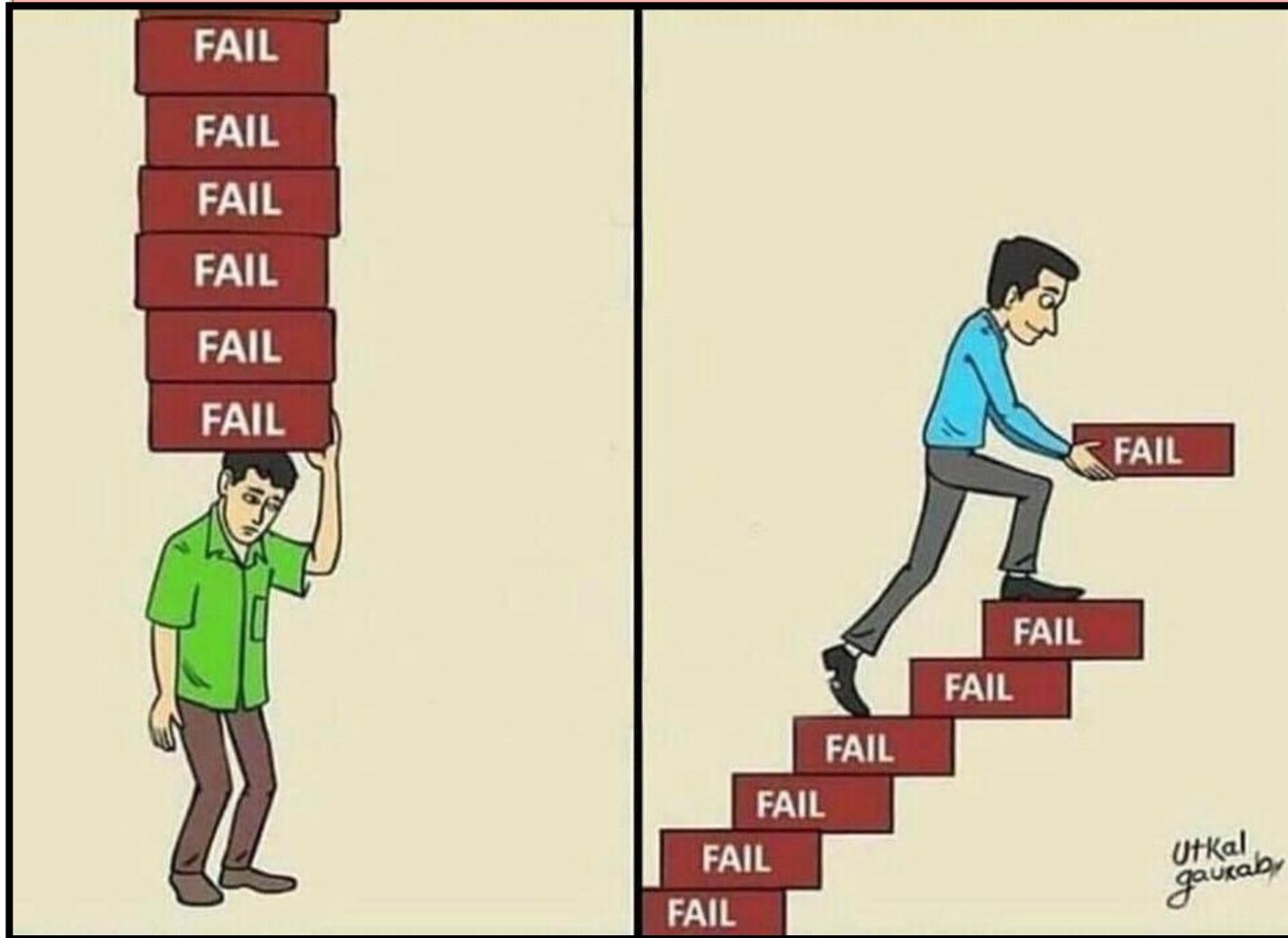
- *“Learn how to learn” — Develop proficiency in doing **research**; cultivate **intellectual rigor, pursue precision and accuracy** in all that you do*
- *Push yourself beyond your comfort zone as you hone your **written and oral communication skills** — and seek opportunities to do **public speaking** (to get more comfortable with it)*
- *Welcome and cultivate multi-disciplinary **teamwork**; celebrate the contributions of others (**Don't be competitive or petty** ~ it shows)*
- ***Seek out continuing-education opportunities** throughout your life (professional meetings, online courses, webinars and podcasts, articles in both academic journals and trade magazines, press releases and e-newsletters from companies and organizations you admire)*

(continues)

Best career advice from the engineers profiled in our book

- *Be constructive and creative about professional development and networking ~ Don't be shy about attending meetings, talking to peers and adults, asking for help/references/recommendations/ideas/introductions*
- *Seek mentors at every stage....and be a mentor to others (such relationships are always win-win for all parties)*
- *Get comfortable tackling problems that have no obvious answers from the outset ~ trust and hone your "Inner Engineer" to think outside the box*
- *In your academic, personal and professional lives: Always maintain and cultivate your values, ethics, integrity and professional reputation ~ Once your reputation has been damaged , it's very hard to repair it*
- *Remain optimistic and resilient in the face of setbacks and challenges ~ everyone has them*

Remember this winning strategy:



Interesting takeaway ~ from the 25 engineers profiled in our book

Some have worked to develop **highly specialized expertise** in a relatively focused field ~

—> *Creating demand for skills they possess, which differentiate them from others:*

- Distillation
- Petroleum refining
- Semiconductor fabrication
- Law/intellectual property

Others have explicitly worked to become expert in a **widely topical area** that is useful across many CPI segments ~

—> *Enabling them to move freely among different CPI segments and employers:*

- Environmental engineering and regulatory compliance
- Safety (process, plant and personnel)
- Powder & bulk solids handling
- Academia

Also ~ Most engineers will ultimately face the choice in their career ~ whether to pursue the “**technical track**” or the “**managerial track**” in their company ~ It’s often a personal choice, based on skills, interests, personality, comfort level and opportunities available (“*Different strokes for different folks*”)

Tips to strengthen your job search

- Use your **career-planning center** and your **alumni networking opportunities**
- **Network shamelessly** — Ask **everyone** you know (professors, family members, family friends, mentors from summer internships and Co-op programs) — if they have any *suggestions or fresh ideas*, or can make any *key introductions*
- Use LinkedIn, Indeed, GlassDoor, CareerBuilder, Experteer, and many other career websites — **including those offered by your university** — to post your resume and to search for job leads

(continues)

Tips to strengthen your job search

- Develop and maintain a “wish list/dossier” of companies to follow — in different industry sectors you find interesting — and scour their corporate websites:
 - * *Look for job postings on the company websites (If possible, sign up to receive alerts from the company as new jobs open up)*
 - * *Read their “Press” or “News” sections to see latest press releases (helps you keep up with latest news from the company, talking points for cover letters, interviews, and more)*
 - * *Sign up to receive news and e-newsletters they offer*
- “Follow” companies, industry trade groups and relevant trade magazines on LinkedIn...Several benefits ~ you will receive:
 - News, press releases, announcements *in your LinkedIn news feed*
 - Alerts to educational materials they are sharing (such as free webinars, tutorial White Papers, and more)

→ This serves 2 purposes: Supports ongoing education, may spur ideas (and names of people) to both **BROADEN** and **TARGET** your job search

Tips to strengthen your job search

- Search online for **industry meetings, conferences and trade shows** related to your areas of interest — Clearly AIChE and the American Chemical Society events, but also events focused on targeted industries:
 - Pharmaceutical/Vaccine R&D and manufacturing
 - Petroleum refining
 - Solar and wind energy
 - Environmental engineering (clean air/water, climate change, sustainable design)
 - Modeling & simulation, artificial intelligence, machine learning and natural-language processing
 - Instrumentation, monitoring and process control, and more
- *Scour the conference programs — Take note of speakers/thought leaders....And their companies... and their timely topics/themes*
 - This will help you to stay current on tech developments, relevant companies and specific people

Two final humorous/interesting stories before I go...

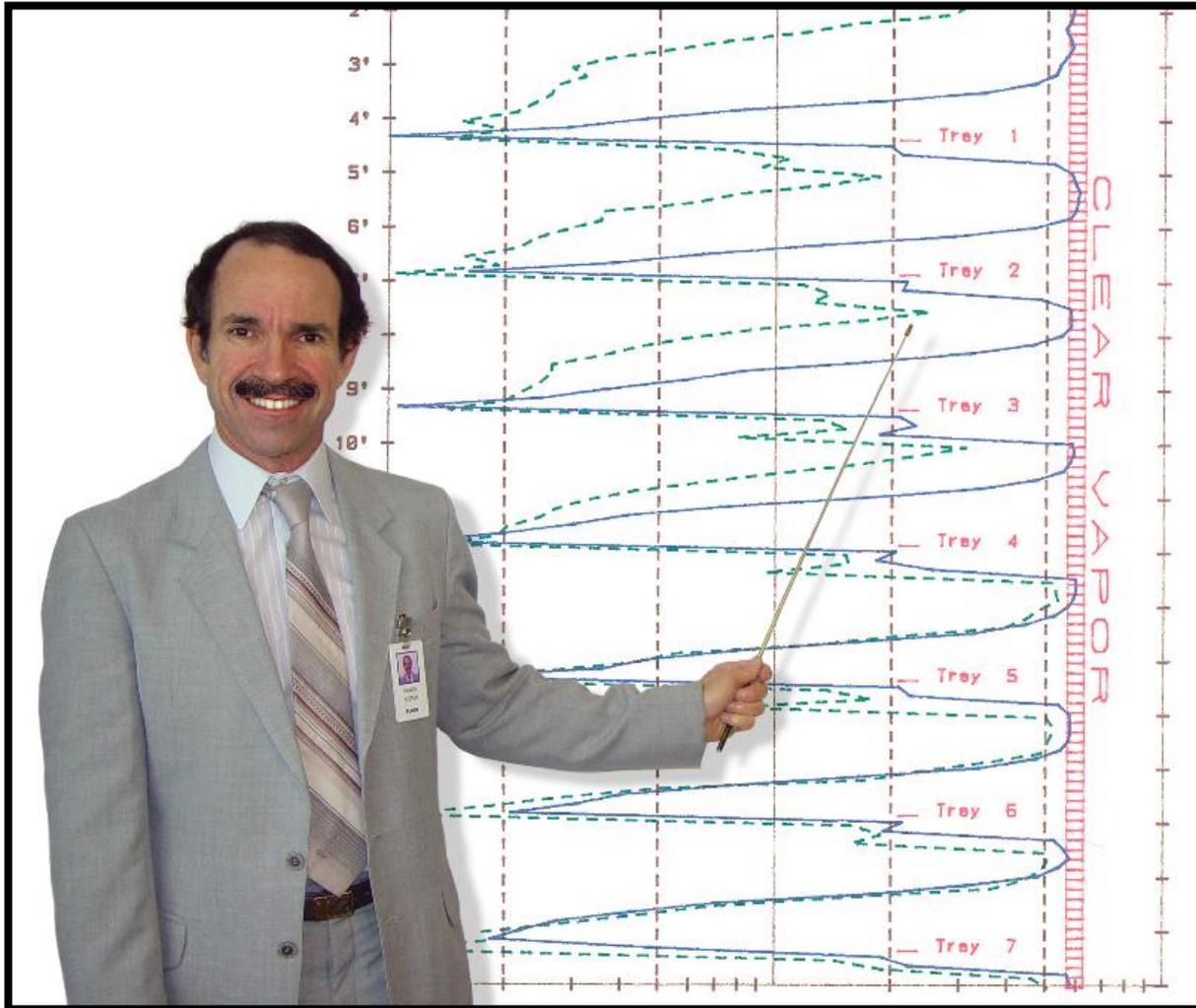
“Never say never”

~ An utterly unanticipated story of
early failure, from one of the
professions most recognized names

...

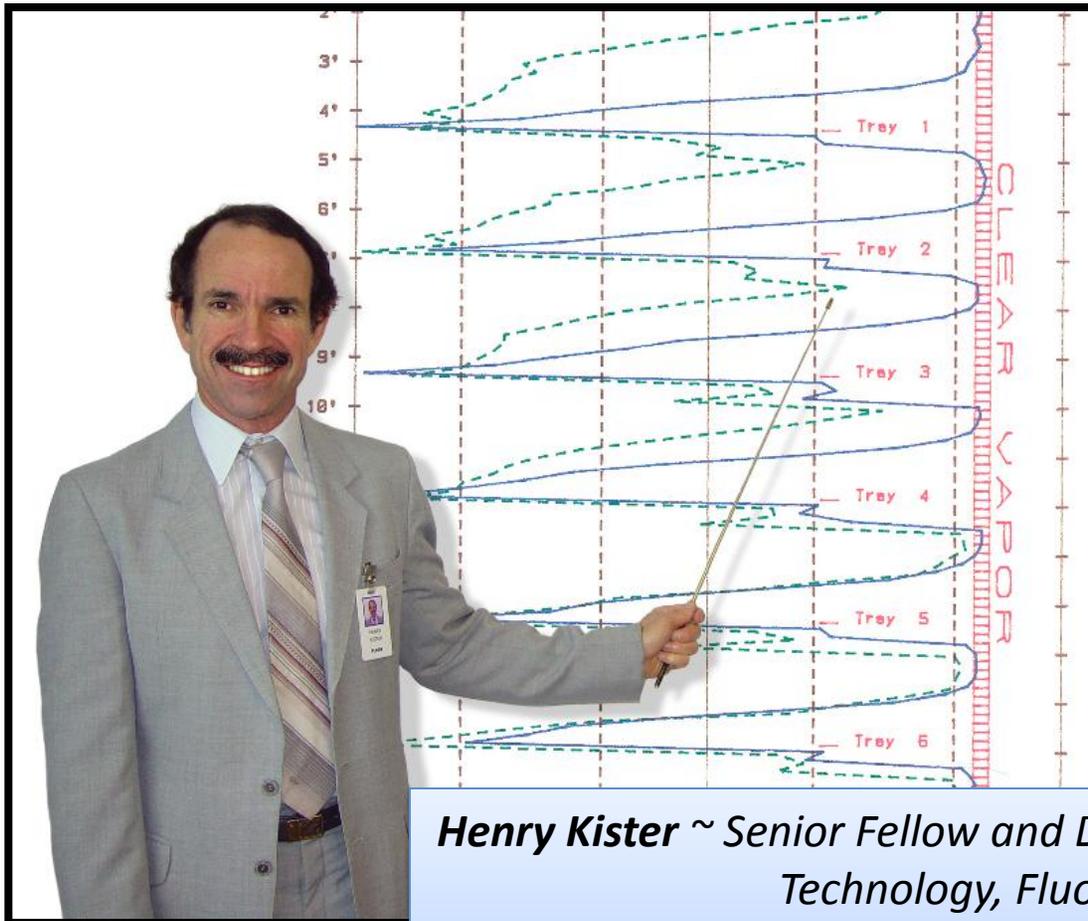
“The enduring appeal of engineering legacies”

~ A fantastic find we accidentally
discovered
on the bookshelf of Dr. Irvin
Osborne-Lee (Prairie View A&M
University)



*Who's
this guy?*

“Never say never...”



*Shhh....
Here's a little
secret: He
nearly failed
Distillation the
first time he
took the class...*

Henry Kister ~ Senior Fellow and Director of Fractionation
Technology, Fluor Corp.
(And **undisputed worldwide expert** in distillation)

“The enduring appeal of engineering legacies”



You'll never believe what we discovered on his bookshelf ~ something he still recommends to his students today...

*Dr. Irvin Osborne-Lee, Professor and Head of the Chemical Engineering Dept.,
Prairie View A&M University (Prairie View, Tex.)*

Joseph F. Shelley, Ph.D., P.E., Professor of Mechanical Engineering, Technology at Trenton State College.
Dr. Shelley earned the Ph.D. at The Polytechnic University of New York. He has authored a three-volume set of textbooks in Engineering Mechanics, published by McGraw-Hill in 1980.

To
Gabrielle
and
Stefanie, Suzanne,
Matthew, and Meredith

Your sweet love
such wealth brings,
I scorn to change
my state with kings

Project supervision was done by The Total Book.

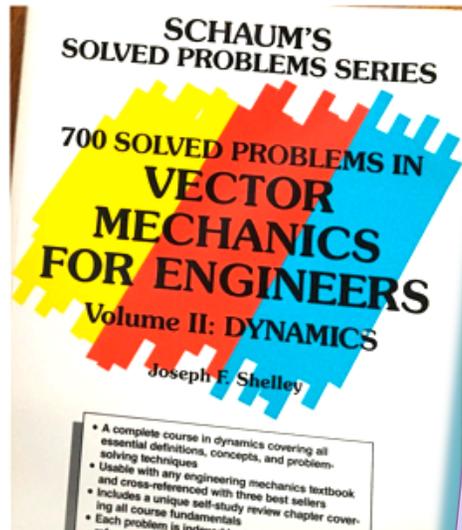
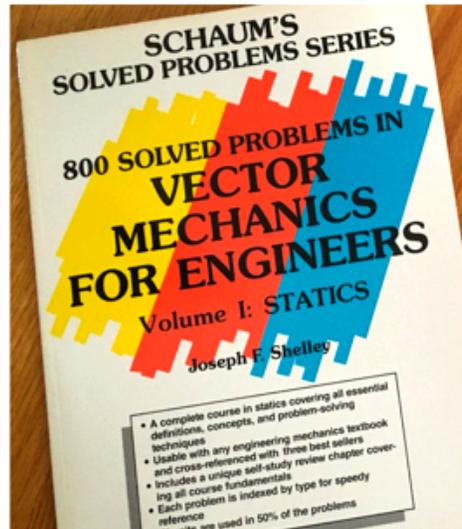
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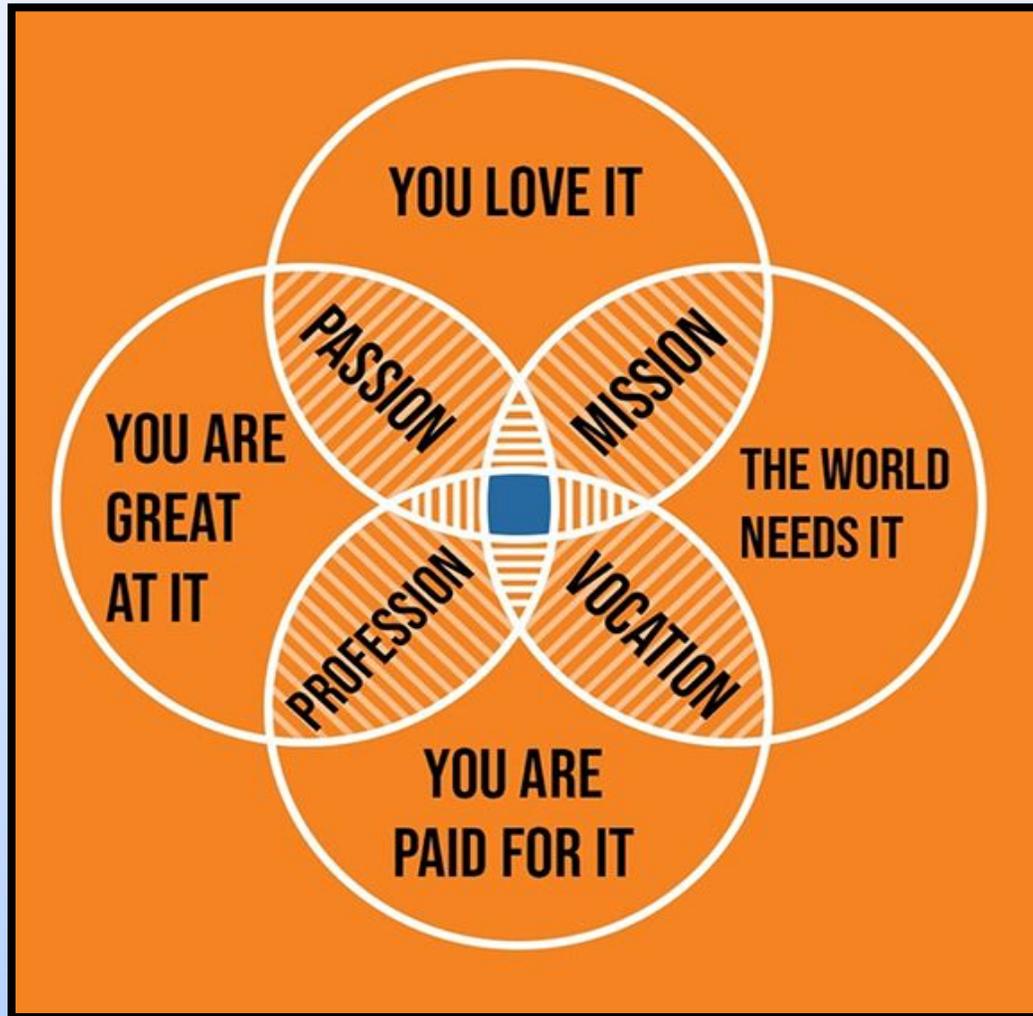


...The two mechanical engineering "solved-problems" books that my Dad has written when I was in 10th Grade...

Dr. Osborn-Lee recommends them to his chemical engineering students today ~ as a way to develop problemsolving skills using unconventional sources

Books out of print now, but used copies can be purchased online ~ (Stunned to discover Dad's books have 5-start rating on Amazon in 2019!)

Aspirational goals for any career



Whether you are just starting out or making a bold career change ~ remember this:



*Final words of wisdom ~
from my dear old Dad...*

***EDUCATION... is the
only thing that
no one can ever
take away from you***

***EDUCATION....
is what remains....
After all that
has been **LEARNED...**
has been **FORGOTTEN*****

Thank you for listening!