

THE FUTURE OF THE CIVIL ENGINEERING PROFESSION

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Halff Associates, Inc.

January 7, 2010

Why Should We Care ?



“If you do not know where you are going, every road will lead you nowhere.”

... Henry Kissinger

“You've got to be very careful if you don't know where you're going, because you might not get there.”

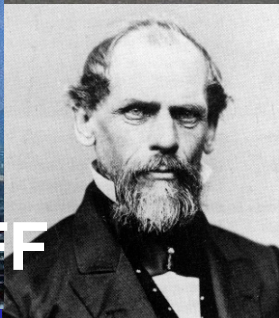
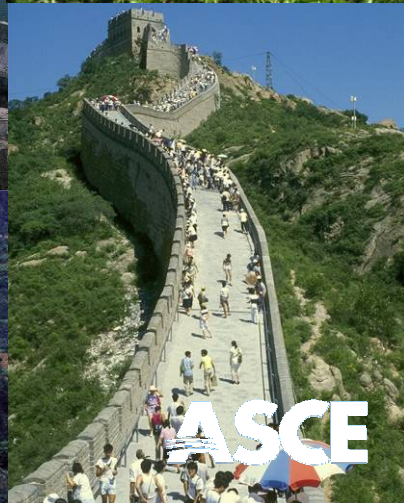
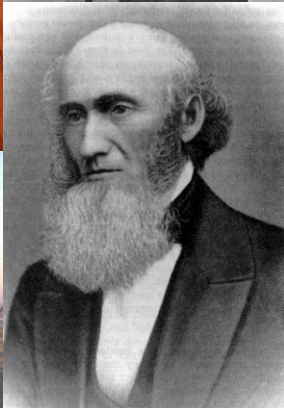
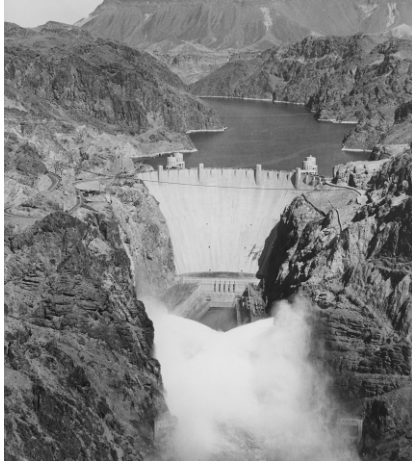
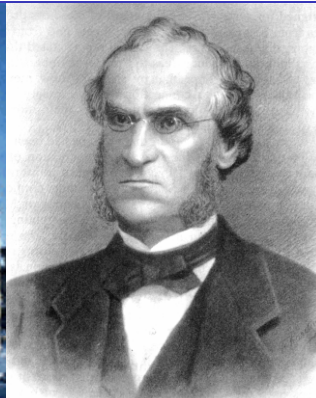
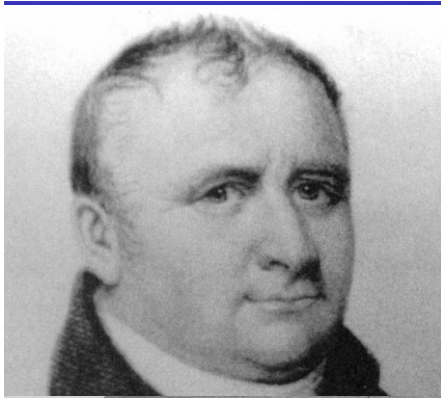
... Yogi Berra



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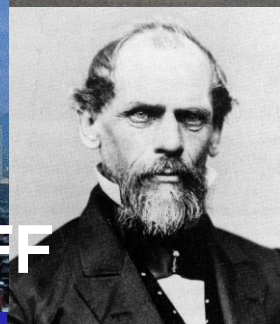
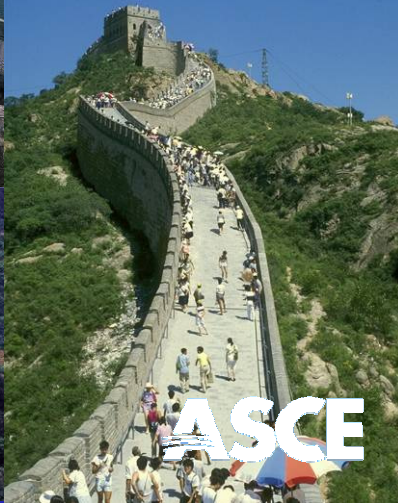
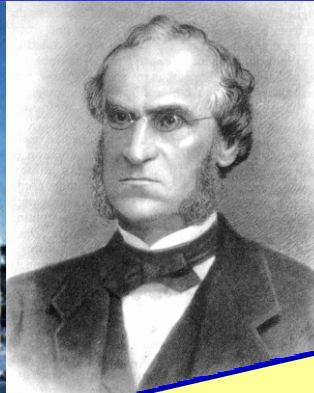
“He who does not look ahead, remains behind.”

... Spanish Proverb



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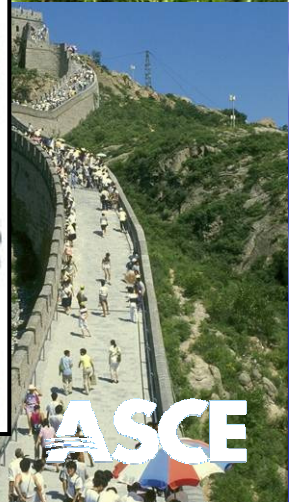
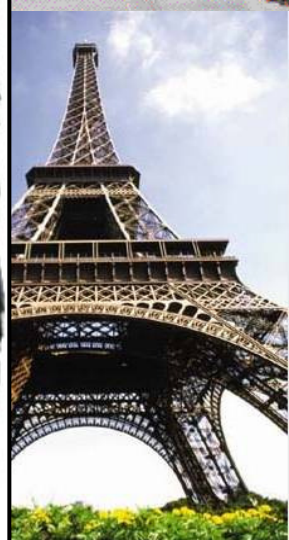
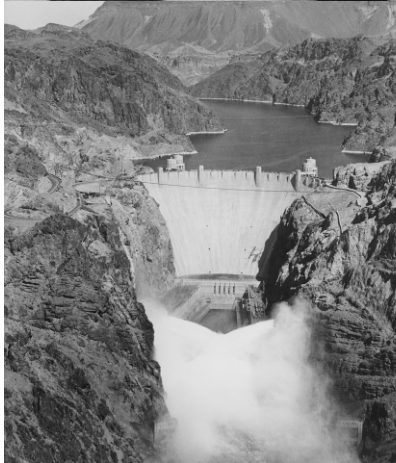
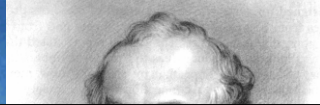




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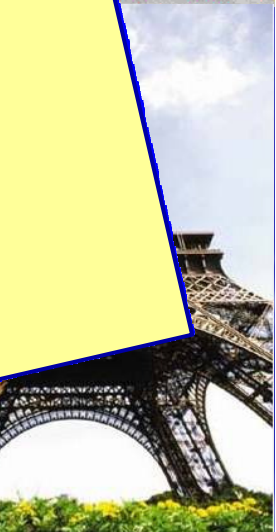
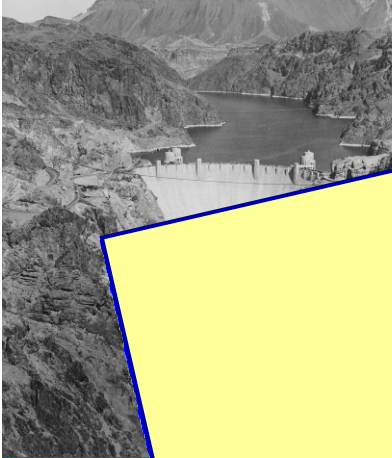
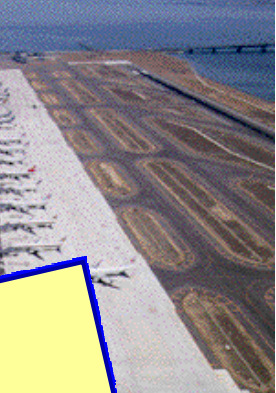
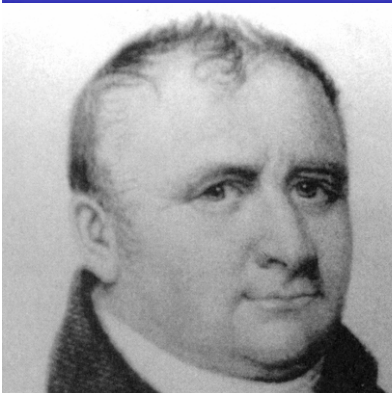
 ASCE

**Civil Engineers can boast
a truly glorious past!**



HALFF





**The future will not look
very much like the past.
We can make it even better!**

A Glance At The Past

“We must welcome the future,
remembering that it will soon be the past;
and we must respect the past,
remembering that it was once
all that was humanly possible.”

... George Santayana

100 Years Ago

- About 8% of homes had a telephone.
- About 14% of homes had a bathtub.
- The average wage was \$0.22 per hour.
- There were about 144 miles of paved roads.
- There were about 8,000 cars.



100 Years Ago

- The median age was 23 years old and the average life expectancy was 47 years.
- More than 95% of births took place at home.
- Less than 6% of Americans graduated from High School.
- Less than 10% of Doctors, Lawyers, Accountants, and Architects attended College.



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- More than 95% of births took place at home.
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- Most Engineers had a 4-year College Degree.



100 Years Of Progress

- Interstate Highway System
 - 41,000 Miles
 - \$114 billion construction cost
 - 35 years to construct
- US Highway Network Today
 - Supports 237 million registered vehicles
 - Over 4 million miles of roads
 - Supports 14 million jobs



100 Years Of Progress

“We do not have great highways because we are a great nation, we are a great nation because we have great highways.”

*... DeWitt C. Greer
Chair, Texas Highway Commission*



100 Years Of Progress

- Bridges
 - Golden Gate, Sunshine Skyway, High Five
- Buildings
 - Sears Tower, Northpark, Winspear
- Dams, Power Plants and Power Distribution Systems
 - Hoover Dam, Glen Canyon, ERCOT
- Water and Wastewater Purification, Treatment & Reuse



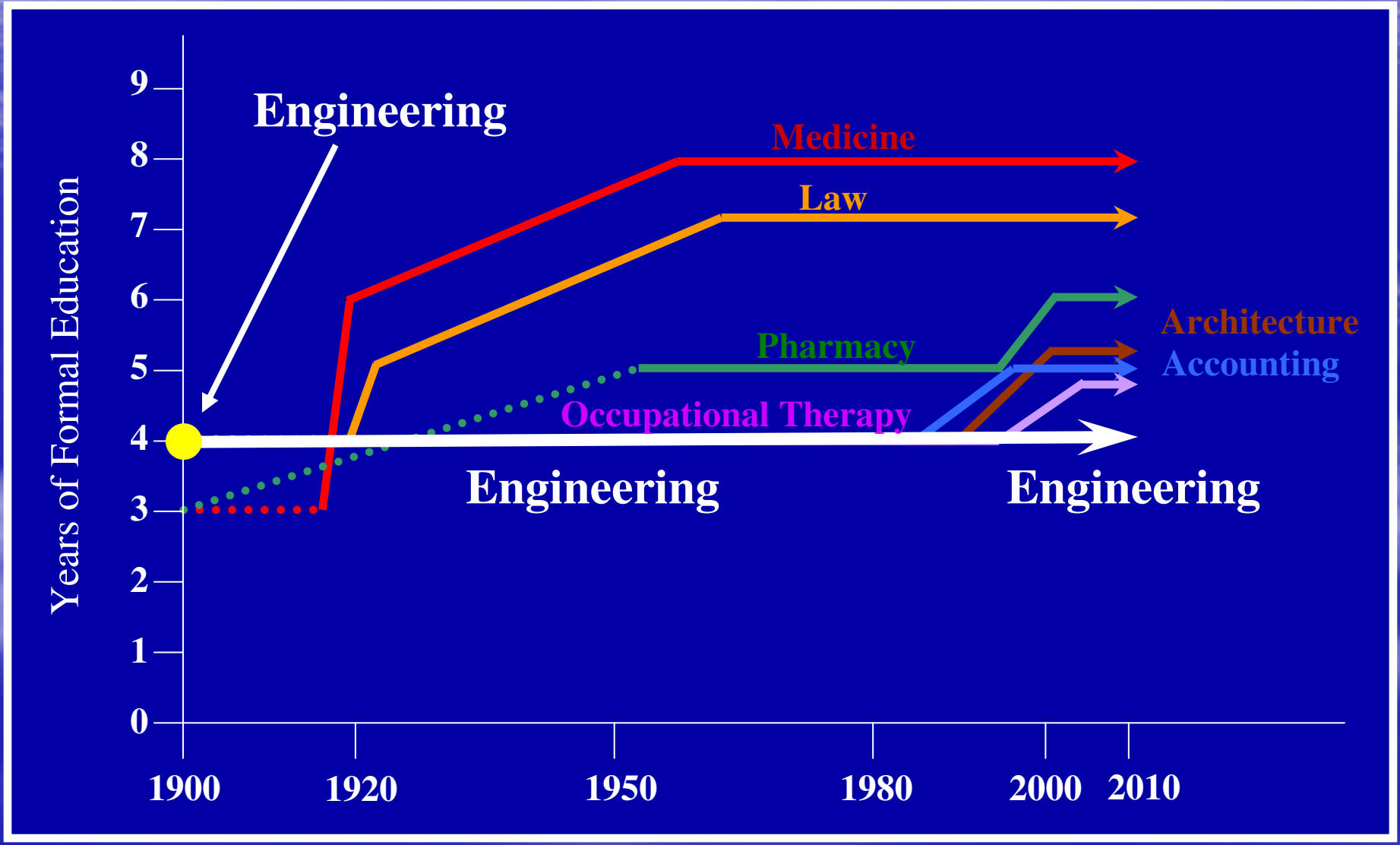
100 Years Of Progress

“The greatest advances in improving human health were the development of clean drinking water and sewage systems. So, we owe our health as much to civil engineering as we do biology.”

*... Lewis Thomas, Dean of Yale Medical School
and President of Memorial Sloan-Kettering*



100 Years Of Progress ?



Where Are We Now ?

“The future is here.
It’s just not widely distributed yet.”

... William Gibson

Issues & Trends

- Infrastructure
- Sustainability
- Generational Differences
- Competency
- Learning/Mentoring
- Prescriptive Design
- Technology
- Security
- Project Delivery
- License Standardization
- Code Standardization
- Risk Aversion
- Globalization
- System Integration
- Role Of The Engineer
- Corruption

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Infrastructure

Years of deferred infrastructure investment and maintenance, and the profession's limited effectiveness in communicating with public officials regarding infrastructure needs:

- Place public health, safety and welfare at risk.
- Hinder the nation's sustainable economic growth and competitiveness.
- Adversely affect the public's quality of life.

Infrastructure

Aviation
Bridges
Dams
Drinking Water
Energy
Hazardous Waste
Inland Waterways



Levees
Parks & Recreation
Rail
Roads
Schools
Solid Waste
Transit
Wastewater

Infrastructure

Overall Grade: D

Aviation	D
Bridges	C
Dams	D
Drinking Water	D-
Energy	D+
Hazardous Waste	D
Inland Waterways	D-



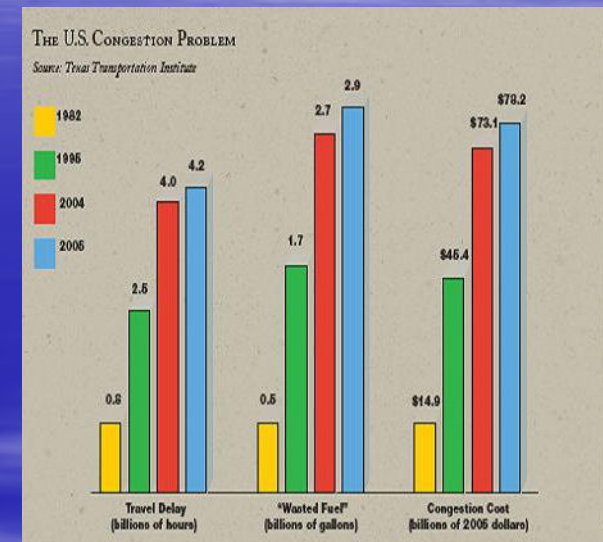
Levees	D-
Parks & Recreation	C-
Rail	C-
Roads	D-
Schools	D
Solid Waste	C+
Transit	D
Wastewater	D-

Infrastructure

- A five year investment of \$2.2 trillion is needed to remedy our current infrastructure condition. Only 45% of that is currently in the federal, state, and local budgets.
- The US population will grow 26% and vehicle miles will increase 60% in the next 30 years.
 - By 2016, aviation passenger traffic will grow 40%.
 - By 2020, there will be 1 billion vehicles on the roads .
 - By 2020, worldwide freight tonnage will increase 50%.

Infrastructure

- Severe highway bottlenecks have increased by 40% during the past five years.
- Americans annually spend 4.2 billion hours per year stuck in traffic, at a cost of \$79.2 billion in wasted time and fuel.



Infrastructure

- At least 27% of the 590,750 bridges nationwide are structurally deficient or obsolete.
- Blocked or broken pipes result in 10 billion gallons of raw sewage flowing into US surface waters annually.



Infrastructure

- Some 2.6 billion people, 40% of the world population, lack basic sanitation facilities.
- At least 1.7 billion people, 26% of the world population, lack access to safe drinking water.



Competency

The increasing breadth, complexity, and rate of change of professional practice challenges:

- The expectation that the BS degree can provide the foundation for the civil engineer to practice at the professional level.
- The profession's ability to assure competence in engineering specialty areas.
- Civil engineers' ability to acquire sufficient non-technical professional skills, thereby limiting opportunities to fill leadership roles.
- Civil engineers' capacity to take advantage of needed life-long continuing education and mentoring from peers, given the limited levels of support from employers in terms of time and cost-reimbursement and the difficulty of finding willing mentors.

Competency

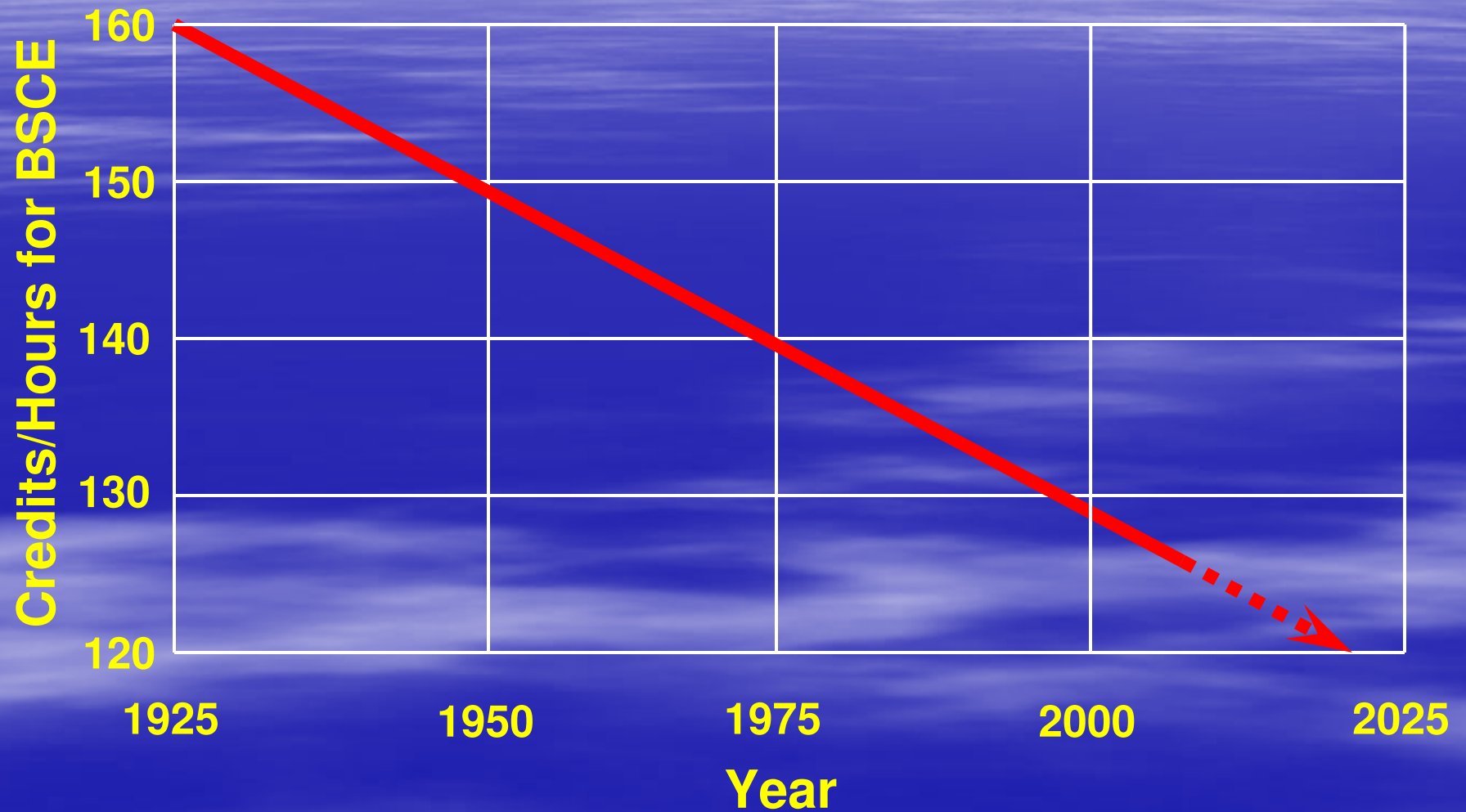
“Scientific and engineering knowledge presently doubles every 10 years. Knowledge is the source of all sustainable competitive advantage.”

... B.T. Wright, VP Engineering, Rockwell Collins

“There will always be demand for superbly educated engineers who are capable of performing in an innovative, creative, and entrepreneurial fashion.”

... Norman R. Augustine, CEO, Lockheed Martin

Competency

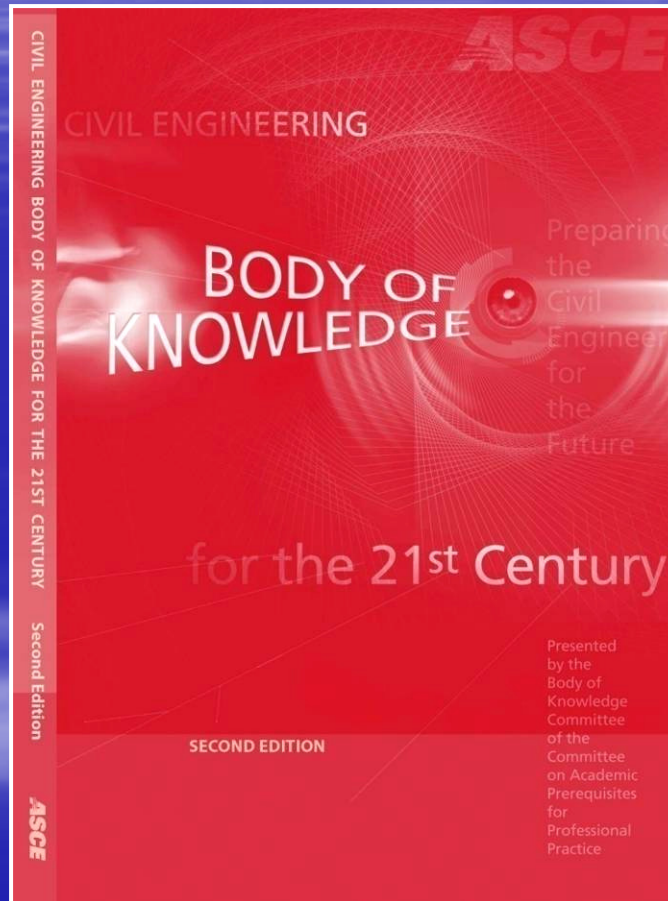


Competency

“While the complexity of engineering and engineering projects is increasing, our formal education is decreasing.”

... *American Society of Civil Engineers*

Competency



Competency

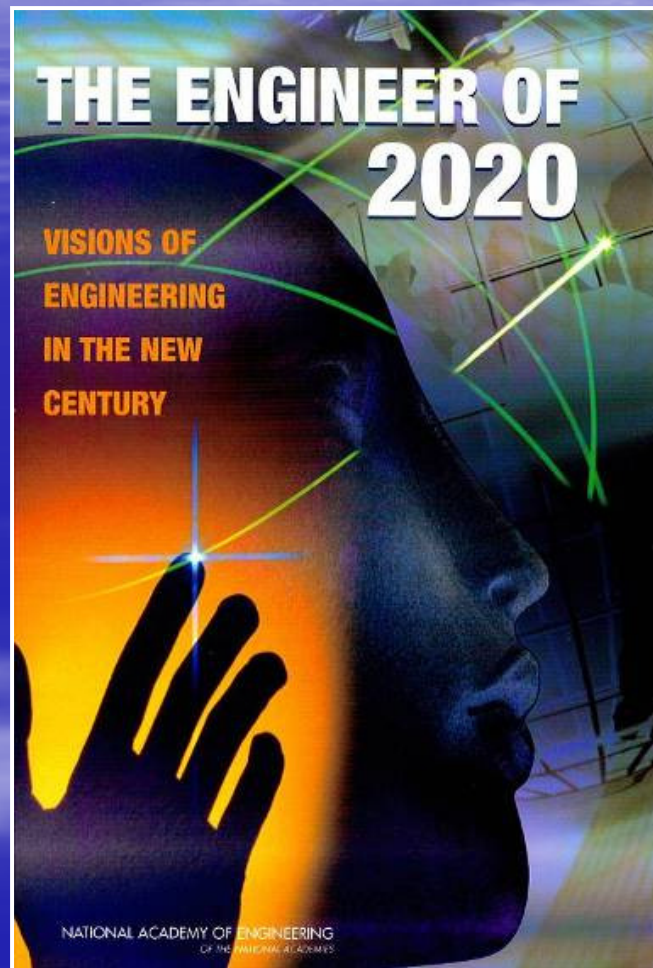
“With the continuing rapid expansion of knowledge required to practice, additional engineering education beyond the four year degree will be required in order to meet the formal academic preparation necessary for the practice of engineering at the professional level.”

... National Society of Professional Engineers

“It is evident that the exploding body of science and engineering knowledge cannot be accommodated within the context of the traditional four-year baccalaureate degree.”

... National Academy of Engineering

Competency



Technology

Rapidly advancing technology will fundamentally change the practice of civil engineering and raise client expectations, yet many engineers are reluctant to embrace these changes:

- Computer-aided drafting and design is detrimental to traditional cost-plus billing models.
- Much of what used to be mainstream civil engineering work is now being done by paraprofessionals and technicians, a trend that will grow.
- Next-generation computer modeling might yield projects without construction drawings, where everything is bid and built from the model.
- Beyond computers, CE practice is being affected by new materials, embedded electronics, robotics, nanotechnology 24/7 communication networks, GPS, and many other new technologies.

Technology

The impact of computers on the practice of structural engineering:

- 1970s – Computerized Analysis
- 1980s – Computerized Design
- 1990s – Computerized Drafting & Detailing
- 2000s – Building Information Modeling (BIM)
- Next? –

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- 1990s – Computerized Drafting & Detailing
- 2000s – Building Information Modeling (BIM)
- Next? – Automated Production of Paperless Construction Documents

Technology

- Many mid-career structural engineers are perfectly content sizing beams and columns. They believe that optimizing such design details is the ultimate calling of a structural engineer. It is undeniable that good engineering design yields tremendous satisfaction.
- Nevertheless, by 2025, these engineers might be just as obsolete as phone operators, bank tellers, and travel agents.

Technology

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- Nevertheless, by 2025, these engineers might be just as obsolete as phone operators, bank tellers, and travel agents.
- They will become more victims of the relentless and ruthless advance of technology ... more victims of the Easy Button!



Project Delivery

Evolving methods of project delivery are changing the way civil engineers work and who they work for, thereby challenging traditional business strategies and relationships:

- How does an engineer avoid doing excessive pro-bono (free) work “up-front” for a losing team?
- How does an engineer ensure quality when the client is also the contractor?
- Does Alternative Project Delivery mean the end of Qualification-Based Selection (QBS)?

Project Delivery

Alternative Project Delivery has many names, such as Design/Build, Comprehensive Development Agreement, and Construction Manager at Risk. Generally, they all mean that the engineer no longer works for the owner:

- 1980s – D/B arrived in Texas, mostly in private-sector building projects (Sunland Park Mall)
- 1990s – D/B allowed in public school projects
- 2000s – CDA embraced on large public infrastructure projects (SH-121, SH-161, New LBJ, NTE, DFW Connector)

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How do local and regional firms continue to participate?

Globalization

The globalization of engineering, and the increasing number of engineers being educated in developing nations, is affecting the practice of civil engineering with respect to:

- How U.S. engineers differentiate themselves from those in other countries through the knowledge and skills U.S. engineers can offer.
- The implications of “off-shoring” and the need for global standards of practice, including the responsibilities of the “engineer of record.”
- The need to have knowledge of international engineering and business approaches, local capabilities, and cultural/linguistic contexts.
- The ability of the U.S. to effectively develop and influence international codes/standards related to civil engineering, thereby impacting U.S. competitiveness in this market.

Globalization

Globalization did not seem like a threat to structural engineers in Texas just three years ago:

- Foreign engineers could not reasonably provide such local services as design coordination meetings and site visits.
- TBPE was strictly enforcing its “direct supervision” rules to prohibit “plan stamping”.

Globalization

In 2005 and before, TBPE Rules stated:

- **§131.81 Definitions**
- In applying the Texas Engineering Practice Act and the board rules, the following definitions shall prevail unless the word or phrase is defined in the text for a particular usage...
- (10) Direct supervision - The control over and detailed professional knowledge of the work prepared under the engineer's supervision. The degree of control should be such that the engineer personally makes engineering decisions or personally reviews and approves proposed decisions prior to their implementation. The engineer must have control over the decisions through physical presence.

Globalization

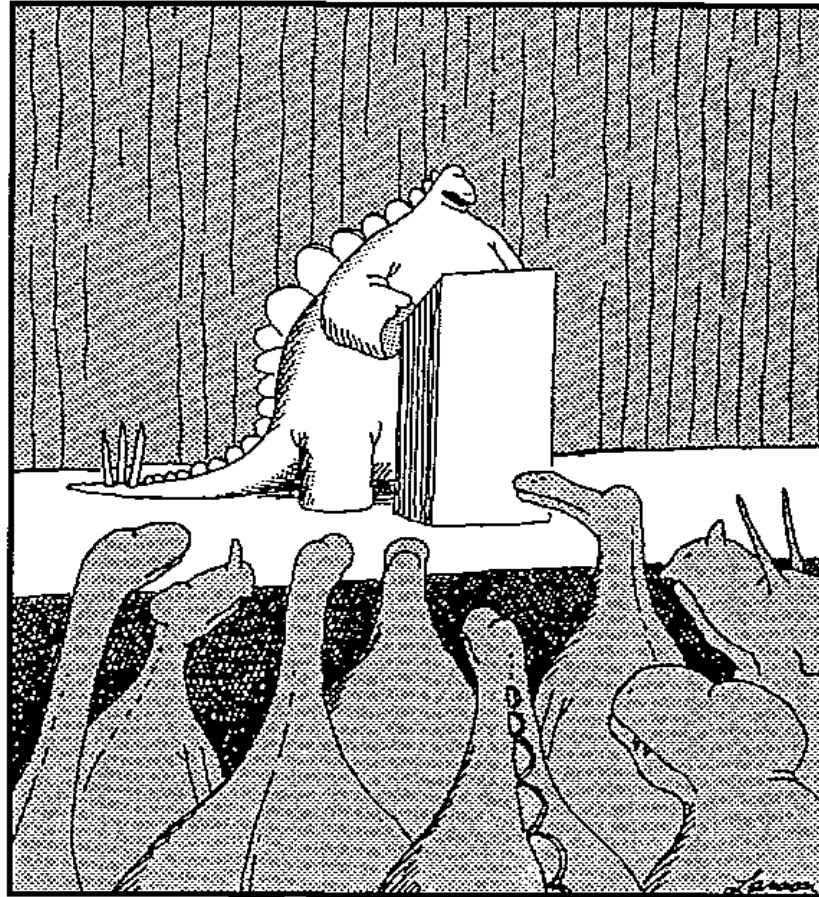
In 2006, the TBPE Rules were revised:

- **§131.81 Definitions**
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- (10) Direct supervision - The control over and detailed professional knowledge of the work prepared under the engineer's supervision. The degree of control should be such that the engineer personally makes engineering decisions or personally reviews and approves proposed decisions prior to their implementation. The engineer must have control over the decisions either through physical presence or the use of communications devices.

Globalization

Later in 2006, a new structural engineering firm popped up in Dallas, touting:

- An impressive portfolio of big projects nationwide
- Unbelievably short schedules (24/7 production)
- Incredibly low fees (80%+/- below market)
- Locally-based Texas PEs for client service
- All engineering design and drafting done in India



"The picture's pretty bleak, gentlemen. ...
The world's climates are changing, the mammals
are taking over, and we all have a brain
about the size of a walnut."

Where Do We Go From Here?



Predicting The Future

“I think there is a world market
for maybe five computers.”

...T. Watson, IBM, 1943

“There is no reason anyone would
want a computer in their home.”

... K. Olson, Digital Equipment, 1977

Planning The Future

“The best way to predict the future is to invent it.”
... Alan Kay, Apple

“We are continually faced by great opportunities
brilliantly disguised as insoluble problems”
... Lee Iacocca

Planning Our Future

“The problems that face us must be viewed as the dreams of the future; dreams that can be realized; dreams that will form the legacy of the next generation.”
... *Blaine D. Leonard, ASCE President*



Planning Our Future

There are only two futures for civil engineering:

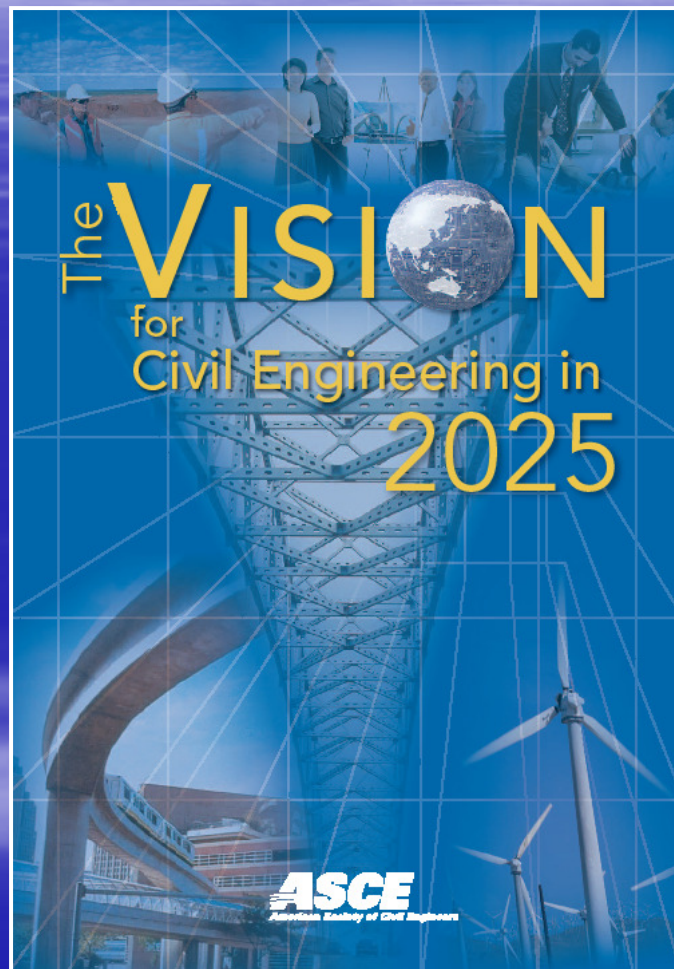
- the one the profession creates for itself
- the one others create in the void

Vision 2025

June 2006 Summit on the Future of Civil Engineering:

- 90 participants and facilitators
- Diverse group of engineers, architects, educators, and thought leaders from 9 countries
- Keynote speakers on critical issues, followed by intensive breakout group discussions
- Charge: To articulate an aspirational global vision for the future of civil engineering, addressing all levels and facets of the civil engineering community ... a global vision to guide policies, plans, processes, and progress

Vision 2025





Vision 2025 is:

- For the entire World, not just for the USA
- For the entire Profession, not just for ASCE
- For the entire CE Community, not just for Engineers
- For a different Time, not for Today



Entrusted by society to create a sustainable world and enhance the global quality of life, civil engineers serve competently, collaboratively, and ethically as:

Master Builders

Master planners, designers, constructors, and operators of society's economic and social engine - the built environment



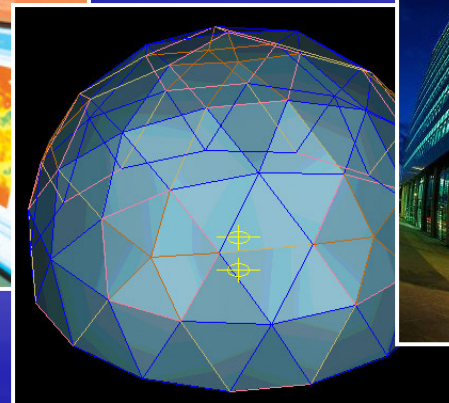
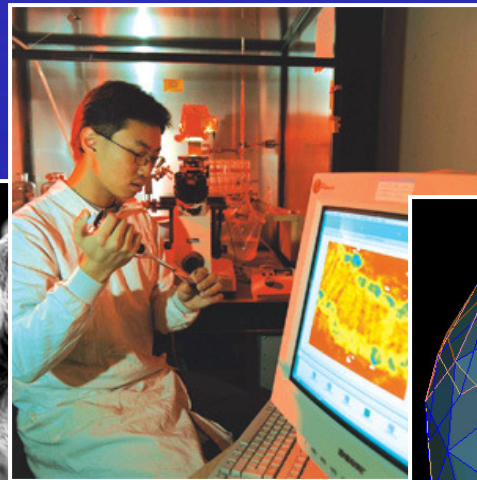
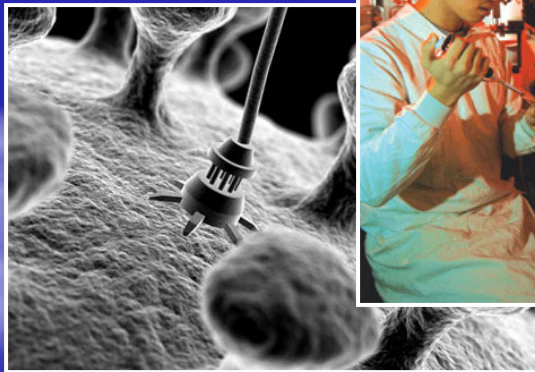
Stewards of the Environment

Master stewards of the natural environment and its resources



Innovators

Master innovators and integrators of ideas and technology
across the public, private, and academic sectors



Managers of Risk

Managers of risk and uncertainty caused by natural events, accidents, and other threats



Leaders in Public Policy

Leaders in discussions and decisions shaping public environmental and infrastructure policy



Vision 2025

Response to Vision 2025 was extraordinary:

- Engineers and engineering societies around the US and around the world embraced the vision.
- High school and college students began to view civil engineering from an entirely different perspective.

But Vision 2025 merely defined the target:

“The Summit’s sole goal was to define this aspirational vision; it was not to create the roadmap on how to achieve it.”

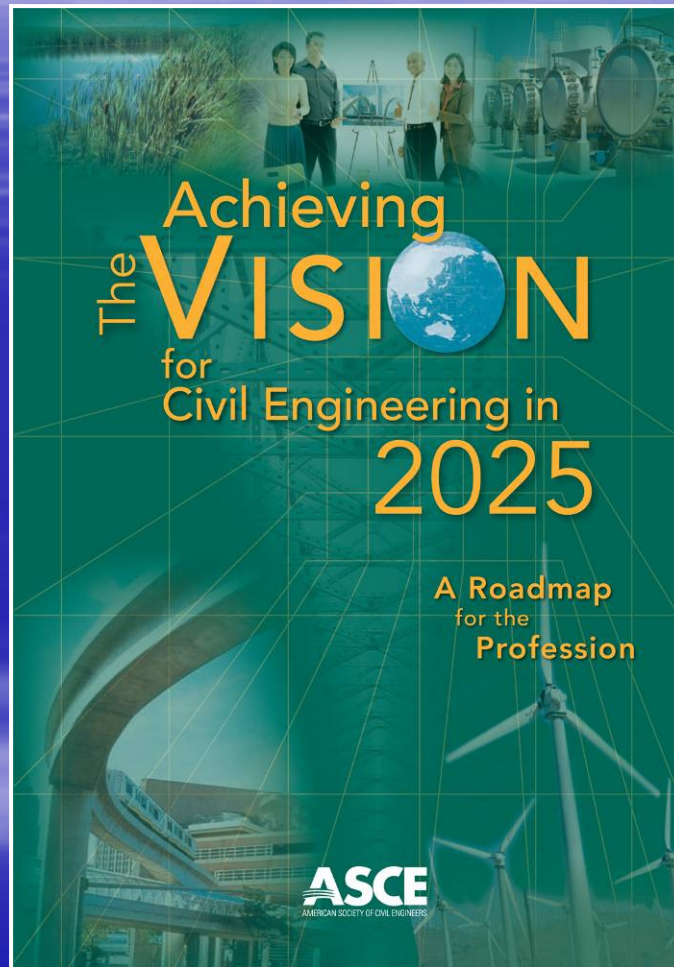
... *Vision 2025 Report*

Vision 2025 Roadmap

ASCE Task Committee to Achieve the Vision:

- 8 members and 6 corresponding members
- Diverse group of engineers from US, Australia, China, Scotland, and South Africa
- More-or-less weekly teleconferences for two years
- Meetings in Reston, Salt Lake City, Boston, and Richardson
- Charge: To create a detailed guide, or roadmap, with supporting outcomes, tactics and actions that will lead to achievement of the vision for the future of civil engineering

Vision 2025 Roadmap



Vision 2025 Roadmap

Entrusted by society to create a sustainable world and enhance the global quality of life, civil engineers serve competently, collaboratively, and ethically as:

- 1 Master planners, designers, constructors, and operators of society's economic and social engine—the built environment
- 2 Master stewards of the natural environment and its resources
- 3 Master innovators and integrators of ideas and technologies across the public, private, and academic sectors
- 4 Managers of risk and uncertainty caused by natural events, accidents, and other threats
- 5 Leaders in discussions and decisions shaping public environmental and infrastructure policy.

“VISION OUTCOME”

Vision 2025 Roadmap

Entrusted by society to create a sustainable world and enhance the global quality of life, civil engineers serve competently, collaboratively, and ethically as:

- Master planners, designers, constructors, and operators of society's economic and social engine—the built environment
 - **Civil engineers facilitate and lead multi-disciplinary, collaborative programs using a systems approach to achieve successful project outcomes.**
 - Civil engineering is universally recognized as a “learned profession” characterized by competency and the continued pursuit of knowledge and experience.
 - Civil engineers have the language and cultural skills, competency, and experience necessary to practice globally.
 - Civil engineers are universally recognized for their high ethical standards of practice.

“SUPPORTING OUTCOME”

Vision 2025 Roadmap

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 - **Civil engineers facilitate and lead multi-disciplinary, collaborative programs using a systems approach to achieve successful project outcomes.**
 - Serve as trusted advisors to owners of projects to define project goals and objectives.
 - Identify the roadblocks to facilitating successful collaborative programs, and develop systems-oriented strategies to remove those roadblocks.
 - **Promote extensive leadership, program management, and project delivery education and training at all levels of career development.**
 - Encourage the education and training of young engineers through mentoring by senior practitioners.

“TACTIC”

Vision 2025 Roadmap

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 - Civil engineers facilitate and lead multi-disciplinary, collaborative programs using a systems approach to achieve successful project outcomes.
 - Promote extensive leadership, program management, and project delivery education and training at all levels of career development.
 - Identify the attributes of successful leaders of collaborative teams.
 - Develop appropriate tools, education and training, and resources to enable civil engineers to assume this role successfully.

“POTENTIAL ACTION”

Vision 2025 Roadmap

5 Outcomes:

- Master Builders
- Stewards of the Environment
- Innovators
- Managers of Risk
- Leaders in Public Policy

24 Supporting Outcomes

106 Tactics

124 Potential Actions

10 Themes:

- Education
- Leadership
- Collaboration
- Sustainability
- Resilience
- Competence
- Diversity
- Globalization
- Advocacy
- Creativity

Vision 2025 Roadmap

- The Vision 2025 Roadmap was unveiled at the ASCE Annual Civil Engineering Conference in Kansas City on October 29, 2009.
- Simultaneously, the Task Committee was discharged.
- Within ASCE, the responsibility for achieving the Vision now rests with the Strategic Planning Committee.
- Beyond ASCE, the responsibility for achieving the Vision now rests with engineering societies and individual engineers all over the world, including YOU.

Vision 2025 Roadmap



What Can You Do ?

- Read the ASCE “Vision 2025”.
- Study the ASCE “Vision 2025 Roadmap”.
- Talk about the future with your leaders, peers, and employees.
- Identify one or more personal skills or attributes that you think you can improve and develop a plan to do so.
- Identify some tactics/actions where you can proactively get involved to help move the profession forward.

<http://content.asce.org/vision2025/index.html>

Credits

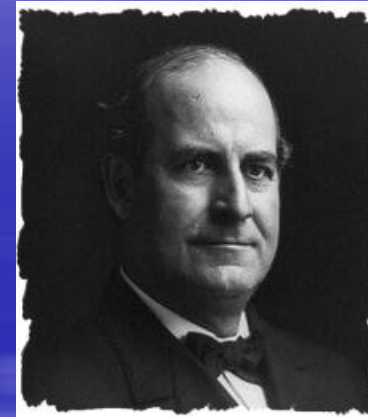
- Blaine Leonard, ASCE President
- Kathy Caldwell, ASCE President-elect
- Jeff Russell, ASCE Chair of CAP3



It's Your Future !

“Destiny is not a matter of chance,
it is a matter of choice.”

... *William Jennings Bryan*



Questions ?