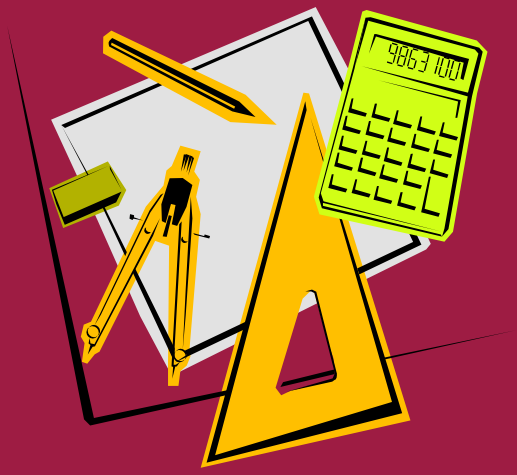
A Brief History of Engineering Education in the U.S.

As it relates to the everyday life of the undergraduate



Origins of the Curriculum – Connecting the Pieces

U.S. Engineering began with the military

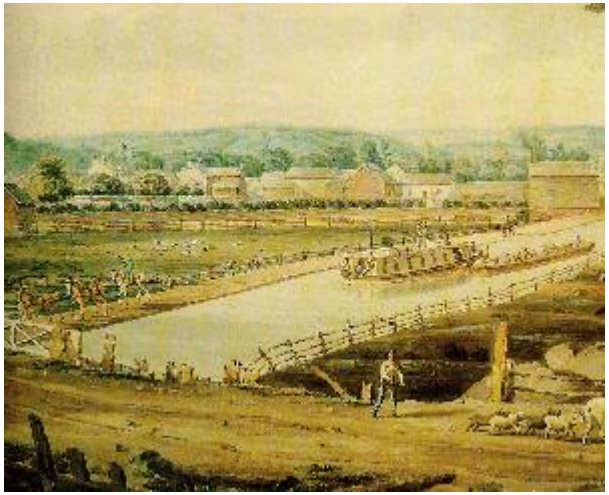
George Washington appointed the first engineer officers of the Army on June 16, 1775, during the American Revolution.

After the War – Victory and Freedom!

but, no way to educate engineers….

The Army established the Corps of Engineers as a separate, permanent branch on March 16, 1802, and gave the engineers responsibility for founding and operating the U.S. Military Academy at West Point.

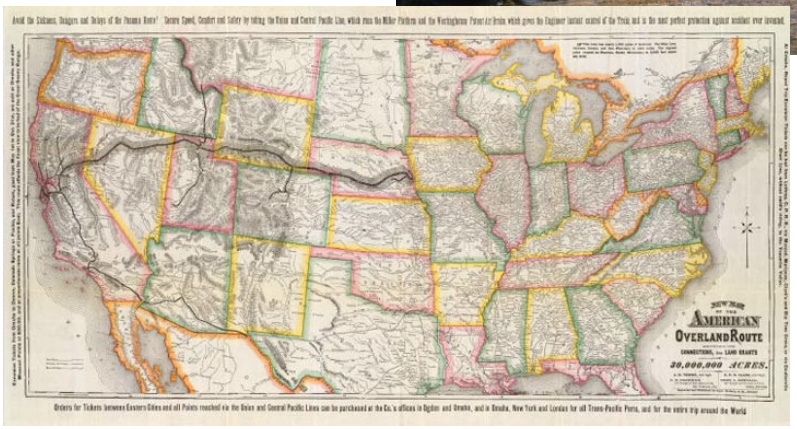
In the 19th Century, U.S. expansion drove the need for engineers



Early on, most American engineers started as apprentices on canal and railroad projects such as the Erie Canal and the Transcontinental Railroad

View of Erie Canal by John William Hill, 1829. From http://www.history.rochester.edu/canal/ , University of Rochester

A few classes (e.g., surveying) were taken to supplement this experience



Source: Union Pacific Railroad Company; Central Pacific Railroad Company. New map of the American Overland Route. 1879. David Rumsey Collection.

The number of U.S. universities began to grow in the second half of the 19th Century

Around the 1850's some schools started following the French model – the 'polytechnics' – Engineering was <u>apart</u> from the university

Rensselaer

This changed with the Morrill Act of 1862 Engineering was <u>a part</u> of the university

Iowa State University of Science and Technology

MIT

North Carolina A&T State University
High Research Activity

Purdue University

Kansas State University

Michigan State University

Illinois

Penn State

The Ohio State University

The University of Wisconsin Madison

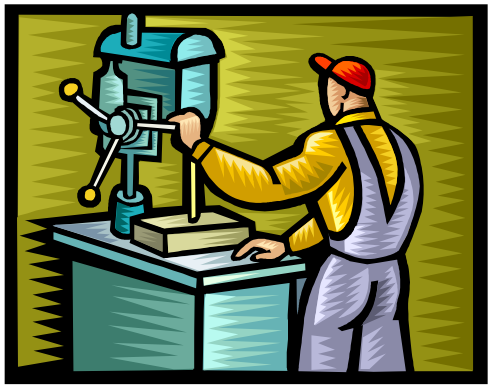
Virginia Tech

Rutgers

Cornell University

MIT and Cornell are the only private landgrants
Confederate states were included after the Civil War
Many HBCU's were founded after the second Morrill Act of 1890

The balance of theory and practice – shop & classroom experiences – evolved…



The shop dominated early engineering programs

In 1885, Robert Thurston (Cornell, ME) pushed to reduce "shop" hours and add basic science in the classroom.

Stillman Robinson (Ohio State), William Burr (Columbia), and Comfort Adams (Harvard) followed his lead.

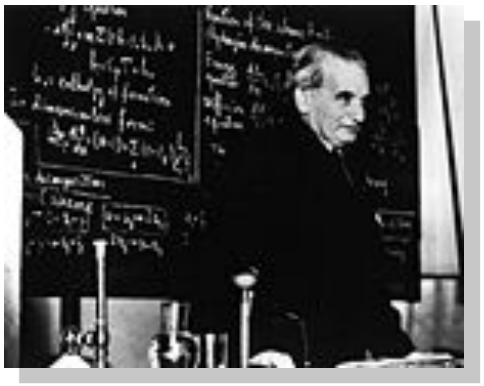
The classroom began to prevail, but progress was slow

The formation of the American Society for Engineering Education in 1893 symbolized the shift.

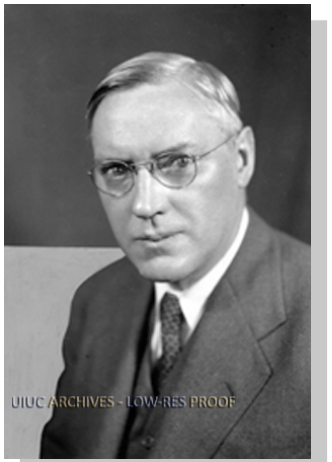
After WW I, the Europeans brought their ideas on engineering education to the US

European leaders in mechanics and fluid dynamics brought complex mathematical analysis…

Stephon Timoshenko (Ukraine) first worked at the U of Michigan (1927) and Stanford (1936). He wrote mathematically based textbooks for the strength of materials, structural mechanics, and dynamics.



In 1930, Theodore von Kármán (Hungary) brought German based theoretical fluid dynamics to Cal Tech. He later helped to found the JPL.



Harald Westergaard (Denmark) worked at the U. of Illinois (1916). He linked civil engineering and theoretical mechanics through the study of bridges, pavement slabs, and dams.

Substantial change did not come until WW II

Radar and atomic weapons brought home the importance of technology
Scientists were given all the credit…

The cold-war and Sputnik prompted federal military funding to support the transformation of more theoretically based engineering

The winning combination resulted from **Federal funding** (cold-war), **European educators** (Timoshenko, etc.), and **status of engineers** (compared to the scientists)

Engineering science was integrated into the classroom

Post-WW II engineering was cold-war driven

Servicemen's Readjustment Act of 1944 (**the GI Bill**), had a significant impact on higher education in the U.S. - thousands of veterans back to school

In the 1950's, the Cold War drove the research funding

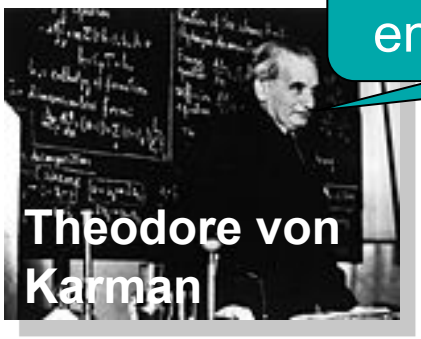
The universities paid little heed to the demands of industry, and adjusted the curriculum to please government demands

The Cold War brought the arms race and the space race and more interest in engineering

Engineering education in the 60's and 70's was dominated by science

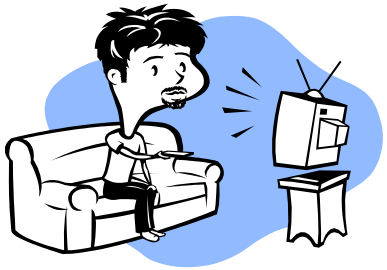
By the late 60's, the pendulum had swung heavily towards science

Practice → **Science**



The very engineers who advocated so heavily for science in the 1930's protested the swing was too far away from design

The '70's offered not much change...



Federal funding to universities was decreased due to recession and oh, that dreaded box…

Instead of tinkering, kids were glued to the TV set!

By the 1980's, hands-on skills dropped tremendously…

Frustration with these lack of skills further fueled shift back to laboratory and design skills

The 1990's brought significant changes in engineering education

Design Rules!

Freshman design, Capstone design (ABET), lab experiences throughout the curriculum become standard

Universities attended more to industry concerns, causing even greater shift away from science to the "hands-on" and applied work

ABET drives ethics…

Now, some closing thoughts for the 21st Century…

"We have moved from a world where the big eat the small to a world where the fast eat the slow" (IBM, Compaq, Dell, next?)

(Klaus Schwab, Davos World Economic Forum)

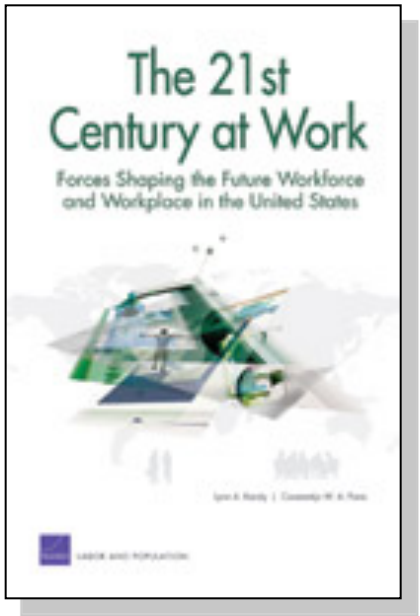
"The US workforce will to continue to increase in size, but at a considerably slower rate… work in the United States will be chased by demographic trends, technological advances, and economic globalization."

(Karoly et al, The 21st Workplace at Work)

And…

The leading edge of American society in the 21st century will be carried by those that are creative and dynamic... Who are able to combine work habit, learning, and values into a single holistic view that enables the creation rather than the mere following of their career.

Ray et al, The Cultural Creatives



"Rapid technological change and increased international competition place the spotlight on the skills and preparation of the workforce, particularly the ability to adapt to changing technologies and shifting product demand … education becomes a continuous process."

(Karoly et al, The 21st Workplace at Work)

Change is constant….