In his introductory remarks, Mr. Augustine referred to himself as (despite a long and varied career in leadership positions of defense manufacturing, government, academic, and non-profit organizations) a currently unemployed aerospace worker. As such he stated that he appreciated the opportunity to talk about subjects he cares deeply about to an audience who could have an impact on his areas of concern. Mr. Augustine also noted his long association with Johns Hopkins and the Applied Physics Lab reaching back to the 1950s when as a graduate student he read about the early efforts in the development of surface to air missiles in reports about Operation Bumblebee.

Hart/Rudman Commission Study
Mr. Augustine was one of the approximately 15 distinguished members of the panel whose report on national security issues came out just before 9/11 with two principle findings:

1. Tens of thousands of Americans would likely die on US soil due to terrorist actions
   a. Not a matter of intel – just logical view of the time because:
      i. There was tremendous hatred of American success by many overseas entities
      ii. After the Cold War it made no sense to wage conventional war against the US and its military power
      iii. Technology now allowed a very few people to have an impact on the lives of large numbers of people
   b. This message from the report was not heard immediately since it came out during all the noise related to the contested 2000 Presidential election
2. National security would be endangered if the country could not better manage education issues related to STEM – science, technology, engineering, and math
   a. Problems in this area could do more damage to the country than any WMD attack
b. This was a surprising outcome from the study which was expected to call for specific numbers of carrier battle groups / air wings / infantry divisions

**The Gathering Storm Report**
- A later study done by the National Academies of Sciences, Engineering and Medicine
- 20 member panel included Nobel Laureates, CEOs, senior academic administrators
- It did not focus on defense topics but came to the conclusions including:
  - Without a strong economy the US would need a strong defense
  - Without a strong economy there would be no tax revenues which would be needed for providing a strong defense
- Big question was: How to build a strong economy within globalization
  - Answer: Innovation
  - To do so required overcoming many other problems including:
    - Salaries in the US are so much higher than those in the developing world
    - Must have increasing numbers of talented and knowledgeable people, which used to come from the ranks of immigrants, but is now restricted
- Two presidents endorsed the report but nothing was implemented
- These concepts are of increasing importance in the world of high technology and growing globalization

**Globalization**
- Globalization was caused primarily by the invention of the jet aircraft and the development of modern information systems – transmission, storage, etc.
- According to an article in the *Economist*: "Distance is dead."
  - How far away things are doesn’t matter any more
  - Not a new idea: an author in 1927 wrote about the one great neighborhood
- As a consequence of globalization the US must compete across the planet
- The business neighborhood also expanded when Communism fell
  - Opened the doors for a large group of educated, motivated people who were willing to work for much less than Americans
- In this new world, the established countries will be the most challenged
  - It is possible to hire 20 assembly workers in Vietnam, 5 chemists in China or 8 engineers in India for the cost of one equivalent employee in the US
  - Productivity rates differ in these countries but not enough to offset the economic difference
  - Over time wages will also rise in developing countries but, given the shear size of potential workforces, problems will remain for established countries
    - It will be decades before reaching equilibrium, especially for less skilled workers

**Scope of the Problem**
- Since 2000 the US has lost one-third of its manufacturing jobs (5.5 million) with the closing of 42,000 factories
• The US is beginning to see the return of some manufacturing jobs but only about 0.6 of a job returns for each one that was lost and only at half of the original wage

• Implications for national security
  o May be able to grow an economy based on a service economy
  o Won’t be able to fight wars on a service based economy

• Not just factory workers feeling the impact
  o Engineers, scientists, professors, architects, radiologists, accountants, etc.
  o Any job that can be shipped across distances is being sent overseas
  o Even R&D and logistics centers

• Estimates:
  o Within a decade 80% of the world’s middle class will be in countries now considered developing
  o Within two decades there will be more middle class consumers in China than in the whole rest of the world
    ▪ China already has 80 million people considered middle class
  o By the mid-2020s there will be 2 billion people in the middle class worldwide
    ▪ The number in China will exceed the entire population of the US at that time by a factor of two
  o By 2050 less than 20% of the world’s GDP will be generated by the US and Europe combined

**What These Estimates Mean for America**
Some statistics:
• Today’s youngest generation will be the first in US history to be less well educated than their parents
  o High probability that they will be less healthy than their parents
• The military says that 70% of US youth not eligible to serve today for mental, physical, or moral shortcomings
• About two-thirds of US parents believe that their children will have a lower standard of living than they themselves have
• According to the Hamilton Institute the median income (in inflation adjusted $$), of men between 25 and 64 fell by 28% during the forty-year period ending in 2009
  o High school grads who didn’t attend college had a drop of 47%
• Studies (including one that led to a Nobel Prize) have shown over the last 50 years 50-85% of US GDP increase could be attributed to advances in science or technology
  o Scientists and engineers make up less than 5% of the US work force but their work disproportionate creates jobs for the other 95%
  o Shows the importance of STEM
  o Each 1% of the population who are scientists or engineers account for 15% of GDP growth
    ▪ Also account for about 14% of the increase in productivity
• By Augustine’s economic calculations in the long term every 1% increase in GDP creates a 0.6% increase in jobs (or about 1 million jobs)
  o May be tapering off but still a large number
• Examples of how these increases come about
IPod, iPad, IPhone, Blackberry, etc. had their origins in the work done decades ago on solid state physics and quantum mechanics. Scientists and engineers who worked on those subjects back then probably had no thoughts about iPods or iPhones or other such devices. Their work created all manner of new jobs and not just for those directly involved with the devices but also in truck drivers, advertisers, etc.

Recent study in the *Journal of International Commerce and Economics* noted that the 700 engineers developing the IPod were supported by:
- 14,000 other workers in the US
- 27,000 worker outside the US

A presidential economic advisor has said: “Venture capital is a search for good engineers.”

Steve Jobs told President Obama that Apple employs 700,000 workers outside the US because they can’t find 30,000 engineers inside the US.

Microsoft is building a plant just across Canadian border since US immigration laws restrict their hiring all the foreign talent that they need.

**Greatest Competitive Edge: US Higher Education System**
- Includes state research universities that educate 70% of all college graduates
- *Times* of London states:
  - Top 5 highest rank universities are all in the US
  - Only 7 of the top 25 universities are not in the US
  - Highest ranking Chinese university is 17th but moving up
- But these numbers may be changing due to a tsunami of a challenge – one not forecast in the *Gathering Storm* – caused by:
  - Most states choosing to disinvest in higher education because the economic downturn has put tremendous pressure on state budgets
    - Universities have been offsetting these losses by raising tuition rates
    - California raised tuition and fees 65% in three years
    - State schools over the last decade have seen their state funding decline by 24% – now smallest fraction of their operating budget in 25 years
  - Rate of increase in tuition has massively exceeded the growth rate of family income

**Immigration Issues**
- US scientific enterprise could have barely operated if it were not for all the talented foreign students who came to attend universities and then decided to stay
  - They stayed to work for US companies or started their own
  - A disproportionate number of companies in Silicon Valley were started by immigrants
- But now the US is facing problems related to immigration
  - The best aren’t coming – they are staying home especially where countries are building up their own university systems
  - There are now more opportunities to work in many home countries
The result is that many foreign students

- Say they are coming to US schools to get educations here, and only stay for a few years to learn US business ways
- Then they intend to go home to make use of their education and experience

- Given these issues the US will need to depend increasingly on homegrown talent, especially in STEM, as developed through the US K-through-12 system

**Problems in the US K-through-12 System**

- Really a system of systems: 14,000 independent systems
  - About 99,000 schools
  - 49 million students
  - 3.2 million teachers

- The US is facing major problems that aren’t easy to fix
  - It takes a long time to fix problems at each of the 99,000 schools one by one
  - To create jobs for all citizens innovation is a necessary but not sufficient condition
  - All citizens must be equipped to live and work in a hi-tech world
    - Not all have to be engineers but they increasingly must be competent in the basics of science and technology

- Problem of attracting STEM students
  - Today only 16% of baccalaureate degrees are awarded in science and engineering in the US while in China the share is 47%
  - Engineering degrees in Asia make up 21% of the total, but only 12% in Europe and 4.5% in the US
  - In these categories, the US was first or nearly so only about 20 years ago

- The domestic pipeline does have some great schools, teachers, administrators but on average they not doing well at all

- The proliferation of charter schools has been positive but not a monolithic success
  - Improvements are made at a glacial pace

- Other positive private efforts (such as Teach for America, Math for America, etc.) exist but they operate only on a relatively small scale

- On international testing comparisons US students are usually near the bottom
  - For 15-year-olds from 33 OECD countries, US students were 17th in science and 25th in math
    - This year the writing scores were the lowest they have ever been
  - In the international PISA Test, the US Class of 2011 high school students came in 32nd out of the 34 OECD countries participating

- In the most recent domestic standardized test (the “Nation’s Report Card”), of 4th-graders 67% were scored not proficient (the lowest ranking) in science
  - By 8th grade that fraction had grown to 70% and by 12th grade it was 79%

- Part of the problem for the US is its size as can seen in an anecdote:
  - The superintendent of a large US school system was visiting an equivalent system in Scandinavia and asked what percent performed below grade
  - Her counterpart responded in surprise that she could list them by name
• Funding not the answer: over the 40 years the NEAP standardized test has been given in the US, real spending per student has gone up 140% and:
  o The number of adult staff per student has increased by 75%
  o Reading and science scores remain unchanged
  o Math scores generally dipped slightly but ticked upward last year
    ▪ But only for the 9-year-old level but companies don’t hire 9-year-olds
    ▪ US might catch up with Finland in 110 years if they don’t improve

Race to the Bottom
• States have figured out that if their students perform poorly on standardized tests, then lowering the standards makes them appear to perform better
• *The Change the Equation* organization’s study showed that only 38% of 4th-graders scored as proficient or advanced in math in 2009
  o But states have been reporting scores based on their own tests 37 percentage points higher
• But can expect even more problems when Common Core curriculum and testing take effect
  o Curriculum was set up under 45 governors and the District of Columbia
  o Initial reports indicate very disappointing results
  o Some parents/school districts are now holding children out of school on standardized test days
• Sometimes hear the argument that the US tries to educate a greater proportion of its children than happens elsewhere – and it is true
  o But the US still does not fare well even when comparing the best US students with the best students from elsewhere
  o Harvard-Kennedy School study: US students scoring highest in math test were significantly exceeded by students in 30 of 56 participating nations
  o Highly accomplished US students with at least one college-educated parent on average ranked behind equivalents in 16 other countries whether or not they had a college-educated parent
• Compared to how the US public reacted when the its Olympic basketball team fell from first place in the world, they seem indifferent to bad education statistics
• *The Gathering Storm* reported many such issues gleaned from many different ranking organizations including:
  o 6th in innovation-based competitiveness
  o 12th in percent of adults with college degrees
  o 15th in science literacy among top students
  o 16th in college completion rate
  o 20th in high school completion rate
  o 23rd in the state of physical infrastructure
  o 27th in life expectancy
  o 28th in math literacy among top students
  o 40th in the improvement of innovation-based competiveness in the past decade
  o 48th in overall K-through-12 math and science education
• Rankings above are a couple of years old and the US has slipped a little further in these categories
  o At that time US was also 86th in optimism about job availability
• Of note: a country can quickly lose the lead in an economy based on high technology
  o Craig Barrett, CEO of Intel, told the Gathering Storm study that 90% of profits on last day of a year came from products that did not exit on its first day
• College Board organization noted that only 43% of college-bound high school seniors met their benchmarks for being college-ready
  o The ACT, which also provides college entrance testing, reported that their figure was 24%
  o For engineering only 15% were considered college-ready
  o These numbers neglect the one-third of high school students who do not graduate and the one-third who do not continue on to college

Causes of These Problems
• Teacher qualifications: 69% of US 5th to 8th graders are taught math by a teacher who does not have a degree or a certificate in math
  o 93% have a physical science teacher who does not have a degree or a certificate in science
  o Personal example: Mr. Augustine took early retirement because he had always wanted to be a teacher
    ▪ Thought he could teach 8th grade math since had a minor in math
    ▪ But he was not considered qualified to teach math in any public school in his state as he did not have a teaching certificate
    ▪ However, Princeton did allow him to teach senior and graduate level courses in their engineering school
• Problems with keeping quality teachers
  o High school teachers in the US need to work 43 hours to make $1,000
    ▪ The average corporation CEOs could do so in 2 hours, 55 minutes
    ▪ Kobe Bryant takes 5 minutes, 30 seconds; Howard Stern only needs 24 seconds to do so
  o So it is not surprising that the US teacher situation is so bad
    ▪ The public appears more willing to pay to keep a good quarterback for its football team than to ensure a good education for its children
• US does not have a problem with the amount of its investment in K-through-12 education
  o US pays more per student (7.4% of GDP) than any other country except Switzerland
  o The District of Columbia, with some of the lowest performing schools, had about the highest level of investment per student in the country
• Mr. Augustine’s travels in 112 countries has made him agree with Bill Gates:
  o Travelling and seeing other countries’ high school systems makes him terrified about the future US workforce
• At the same time, it is risky for the reelections of school board members who try to improve the situation by having students spend more days in the classroom
  o On average today public school students spend 180 days in the classroom each year, while in China the number is 220 days
  o In 2011, 292 US school districts changed the length of the school by shortening them to 4 days – mostly a consequence of budget pressures
• One study estimates that if the US could increase the academic achievement of its high school graduates to equal that of Finland, the US could increase its GDP equal to about the equivalent of three of the recent stimulus packages each year

Some Successes
• Harlem Success Academy, which admits neighborhood children by lottery, examined students in standardized tests
  o Six comparative nearby schools showed 31% were proficient in reading and 39% were proficient in math
  o Harlem Success Academy students were shown to be 88% proficient in reading and 95% proficient in math
• However, not all charter schools have been this successful but overall their success has been compelling

Consequence: Growing disparity in the population (1979-2004)
• Top one-fifth of US workers had their earnings increase by 69%
  o Bottom one-fifth had their earning increase 9%
  o Top 1% had earnings increase of 176%
• Only 15% of US high school graduates are qualified to attempt an engineering degree and only half of those graduate
• Despite the recent period of technological advances the number of physical science, engineering and mathematics bachelor degrees has fallen by over 20%
  o A slight turn around recently perhaps indicates the loss of attraction to Wall Street
  o During the same time, MBAs grew by 120% and law degrees by 20%

Myths and problems to overcome
• While there is a perception that STEM professionals aren't paid well, at any given level of education they tend to make 26% more than those in all other professions
• Graduating from college rather than just high school usually means about a $1M difference in earnings over a lifetime
  o It seems as though that fact should be enough to push people into college
• During the recent unemployment crisis which was reported to be a little over 10% but was actually more, the STEM professions unemployment rate was about 5.5%
• STEM should be more attractive than it is but the problem is leakage in the “STEM Pipeline”
  o To get one PhD engineer in 2030, must start out with 3,000 8th-graders in US public schools today
Lack of women and minorities in STEM

- **Anecdote**: A friend recently reported on going to the movies in Russia
  - He likes going to the movies there because the engineer always gets the girl
  - This points to two problems with the more important problem one being that half the population in the US (women) aren’t becoming engineers
- **Statistics** – women make up:
  - 20% of bachelor’s degrees in engineering
  - 19% of PhD graduates in engineering
  - 58% of college students
  - 72% of high school valedictorians
  - Majority of graduating lawyers and doctors
  - Bottom line: STEM is not attracting women
- **The situation with minorities is even worse**
  - African Americans and Hispanics, who each make up about 12% of the US population
  - Yet each group make ups a little less than 5% bachelor’s and doctorates awarded in science and engineering
- **Bottom line**: With this situation, country has more than half of its capability not on the playing field for STEM, making it very hard to prosper

Despite all the problems mentioned, the US will never again suffer a shortage of engineers. In a globalized world, since it is so easy to move such jobs abroad, it becomes a self-fulfilling prophecy that many will not choose engineering as their jobs could get outsourced.

**Future of US Education**

- **Will depend much more on the federal government than state government support**
  - States are in worse shape financially than the federal government
  - Also, the great industrial research and development organizations like Bell Labs have seen their best days
- **Some executive viewpoints**
  - Survey of Fortune 100 CFOs: 80% would cut their research and development budget if they could not meet the next quarter’s financial forecast
  - Intel Corp executive: We go where the smart people are
    - Current operations are two-thirds in US and one-third overseas
    - That ratio will flip over in the next 10 years
  - DuPont executive: if the US doesn’t get its act together DuPont will be moving to countries that do
  - Bill Gates to Augustine: We are going to go where the high IQs are
  - Survey of Fortune 500 companies: 47% of business now outside the US
- **Bottom line fear**: firms will do well, CEOs will get bonuses, and shareholders will get dividends but there won’t be jobs in the US
- **There has been a Blame China reaction** to many of these problems recently and China does have a lot to be blamed for but:
- China doesn’t control US schools, decide how many students study engineering or science, or train US teachers
- In testimony to Congress, a Congressman asked why Mr. Augustine was always there asking for more money for education during a budget crisis
  - Reply: As an aerospace engineer he worked on many aircraft designs that were too heavy to fly and had never fixed a problem by removing an engine
  - President Obama used the same analogy in the State of the Union address
  - Must think of science and education as engines of innovation and must support them no matter how difficult the budget situation is

**Bottomline Thoughts**
- National security depends on the economy
  - The economy depends on innovation
    - Innovation depends on research and engineering but these areas are losing ground
- Some short-form actions that could be taken such as
  - Introducing the free enterprise system to K-through-12 systems
    - Has worked in all other areas including higher education
  - Paying:
    - Whatever it takes to get someone with a physics degree to teach physics
    - A great physics teacher a lot more than a good physics teacher
    - To help a poor physics teacher find a new career

Anecdote highlighting the challenges US education must face:
- Mr. Augustine, when working on a project for NASA about the future of space, was asked to speak to his grandson’s pre-K class about the subject
- He prepared extensively and developed a secret back-up plan
- Things went well for awhile but then Mr. Augustine felt he should turn to his back-up plan: He asked the kids if they wanted to ask an astronaut a question
  - He called Buzz Aldrin and put him on the speaker phone with 4-year-olds
  - The experience was very popular with the kids and the staff and other classes who came in to listen
  - All the kids went home and told their disbelieving parents they had talked to Buzz Lightyear in school that day
- Bottomline: There is much to do to improve teaching
  - Teachers do know how
  - The country needs the courage to support teachers adequately
  - If the education system is properly supported, the US will have a stronger economy and nation as well as a better life for Americans, leading to a stronger national security
QUESTION & ANSWER SESSION

RE: PAY STRUCTURE FOR TEACHERS
- It will take a shock of some kind to force a change in how teachers are paid
- Unfortunately, the growth of the country’s problems is much like slowly boiling a frog – increasing the pain very slowly
- A potential shock would be China saying that it was launching a spacecraft to land on the moon, but then lands on an asteroid instead
- The US needs that sort of shock to make changes
- There are changes being made at the grass root level but it isn’t enough since the changes are only local and don’t address the magnitude of the problem

RE: POST-COLLEGES DEBTS / GLOBAL SKILLS / JOBS MOVING OFFSHORE
- College debt problem is a time bomb waiting to go off
  - Will explode when interest rates go back up
  - Look at what fraction of the GDP must go to paying off debt
- Ironically, don’t need more money in K through 12; do need it in research
  - Could triple the research budget without having an impact on the national budget trendline, i.e., it’s an incredibly small percentage of the budget
- In a *Wall Street Journal* op-ed Mr. Augustine wrote that US students do worse in history than they do in math or science
- Can expect that even service jobs are moving off-shore
  - CAT scans are already likely to be read by doctors in India or Australia
  - An office in DC has a receptionist on screen who is actually in Pakistan
  - Man in Paris had his gallbladder removed by a surgeon who was in New York
- Bottom line: The US can’t build economic walls around itself (such efforts have always failed in the past); it can only compete

RE: SUGGESTIONS FOR IMPROVING THE K-THROUGH-12 SITUATION
- Recommendations from *The Gathering Storm*: US government should competitively award 10,000 scholarships for math, science, engineering, and languages annually
  - Recipients would get a teaching certificate along the way and then teach for five years in a public school
  - Currently, 47% of teachers leave after five years so no worse off
  - Hope that some of the best will stay on
- Teachers’ unions should be more concerned about the top 50% of all teachers rather than concentrating on taking care of the bottom 2%

RE: IMPLEMENTING RECOMMENDED CHANGES
- Will take some shock for those that make changes to force them to do so
- Problem: both big business and government are set up for handling the short term
  - Business only thinks about the next 10 years
  - Government’s only concern is about the period until the next election
  - But education problems involve a generation
- It has been said that you can’t move CEOs but you can move their food
RE: ESTIMATES ON THE FUTURE OF THE ECONOMY

- The problems:
  - The stock market is over-inflated
  - Corporations are sitting on a lot of cash but much of it is overseas
- Short term: expect lots of ups and downs, with nothing spectacular
- Long term: does not look good given the problems discussed previously
  - However, it is not too late to fix the problems
- Optimism vs. pessimism: A pessimist is an optimist who has been shown the facts

RE: NATIONAL LOSS OF MECHANICAL AND OTHER BASIC WORK SKILLS

- US has become too much of a throw-away society
  - While in the Pentagon Mr. Augustine read maintenance logs for various facilities that would report problem fix as “replace bad part with a new part”
- US has become dependent on its machines and systems but should worry about what happens when they quit working
  - True in both military and civilian settings
  - Immediately after 9/11 those industries which were dependent on just-in-time delivery systems had no way to get the parts they needed
- Hospitals have a problem with needing to avoid having empty beds but many beds would be needed should there be a major biological warfare attack
- All countries are facing these challenges
- In a related note: Not everyone needs to go to college
  - Would be best to have some good carpenters, pipe-fitters, tool-and-die makers, etc.
  - Community colleges now are behaving as prep schools to help graduates go from poor high schools to four-year colleges
    - They need to go back to being trade schools with apprenticeship programs
    - Germany has adopted this strategy and has handled the most recent economic crisis comparatively well

RE: DoD AND CURRENT BUDGET RESTRAINTS

- Principle: In hard times it is better to do less but do it with very high quality
  - So if there is a choice it would be preferable to have a smaller military and defense industry but one that is of high quality
- The military now has an opportunity to reshape itself – something that doesn’t happen very often
  - Same thing happened in the defense industry between 1990 and 1995
  - Industry restructured itself – became smaller but more efficient
- Worst thing to do is to try to keep doing everything they have been doing but telling everyone to just try harder – won’t work
- Must face fact that by doing less there will be an increase in risk
  - Can’t believe that reducing by 30% will not have an impact on risk
  - If it were true, then weren’t working very well before
- Decidedly, a major challenge for the military
RE: REGULATIONS AND RESTRICTIONS
To explain how over-regulation can be dangerous Mr. Augustine told the story of the problems he ran into when his grandchildren tried to sell lemonade for charity. His young grandchildren and their friends set up a lemonade stand near their homes across from Congressional Country Club during a major golf tournament to raise money for children with cancer. When Mr. Augustine arrived he saw his grandchildren surrounded by TV trucks and a car from the county regulation bureau. The county official wanted to confiscate the lemonade since the children had no license to sell but instead insisted that someone would have to go to court. The children couldn’t and their mothers had walked there from their nearby homes without any identification. Mr. Augustine was then issued a summons to appear in court to face a $500 fine. The press coverage went viral and shortly thereafter county officials decided to drop the charges.

RE: TECHNOLOGY AND EDUCATION
- The Khan Academy is one example of using modern technology to improve education
  - (Wikipedia: The Khan Academy is a non-profit educational website stated mission is to provide "a free world-class education for anyone anywhere")
  - Some universities also using more technology but basic classrooms have not change in decades
- Technology like that used by the Khan Academy will probably have an enormous impact on K-through-12 education
  - Particularly where students can learn at the own pace
  - Kids today are attuned to this style of learning
- Less clear is how this will impact universities using MOOCs and other open course structures
  - Traditionally great universities had great libraries and great faculties
  - Today students carry libraries in their pockets and have access to world-class faculty from around the world using distance learning
    - Often students don’t even have to pay for this
- Bottom-line: there is potential to undermine the great campus-based universities if it is not done correctly

RE: AMERICAN CULTURAL ADVANTAGES
- US does have huge cultural advantages starting with democracy
  - Not in every country would a company be free to relocate its headquarters
- The free enterprise system provides great opportunities
  - In the U.S., companies that do right, tend to prosper and those that do wrong go out of business
  - In many other places even bad business are preserved and just gradually get worse and worse
- The higher education system (college) is still a great advantage
- Shale gas recovery, if it is done right, could have a tremendous impact but it is also a cause for some concern especially if a mini-Fukushima or Gulf situation occurs
- Culture of innovation and challenging the bounds is a great advantage
Example: In the early days of the Space Shuttle Martin Marietta was building the huge fuel tanks for the shuttle, but the weight needed to be reduced by 8,000 lbs.

- Engineering managed to do away with 7,200 of the 8,000 lbs.
- Someone casually suggested not painting them white
  - But space hardware was always painted white!
  - However, calculations were done to learn that the paint weighed 800 lbs.
- Result: first few tanks were white and the rest were orange, the color of the sprayed-on foam, also costing less and reducing cycle time
- Bottom line: happened because someone was willing to challenge the way things had always been done

- Warren Buffet was asked what was the most important thing he had ever learned: Always have someone around to tell the emperor he had no clothes
  - Need someone to tell you that you are messing up
  - Comes from the culture of acceptance of people who are willing to challenge the status quo

- The American culture also accepts that people will Speak Up – sometimes more than you would want them to

RE: STANDARDIZED TESTING

- If all classroom time is spent on testing, children won’t learn very much
- But, it is also necessary to have feedback for the teacher and the student
  - Without it, no way to know how or where to get better
- Challenge is to find the optimum balance
  - In some cases too much time has been spent on standardized testing
- Bottom line: It is very important to have selective standardized testing
- Some people say that teachers spend too much time teaching to the test
  - But that is what should be done if the test is correctly built
- Some people also say that there shouldn’t be scorekeeping in baseball since it puts too much pressure on the players
  - Mr. Augustine can’t agree with this concept
  - There needs to be feedback – but must be testing on the right things
- Also can’t spend all of the time testing
  - Teachers today overburdened with tasks that have nothing to do with teaching
  - Researchers have the same problems