

In February, the Emerging Issues and Trends Committee surveyed ASFE’s general membership to help set the focus of its bi-annual Summer Crystal Ball meeting. The results of the survey (summary follows) were used to seek out, and secure subject matter experts for their input into identification of major trends that may be of interest to ASFE member firms.

Summary results of the survey (note that the scores are like golf – lowest score is the highest priority):

Looking forward, please rank the following five areas in terms of how significantly they will impact our professions between 2016 and 2021. Rank 1 the issue that you believe will have the most significant impact; rank 2 the issue that will have the second-most significant impact, and so on.

Answer Options	1	2	3	4	5	Rating Average	Response Count
Infrastructure (aging, financing, etc.)	53	20	12	12	5	1.98	102
Natural Resources (oil, water, food, minerals, air, etc.)	23	41	24	11	2	2.29	101
Political (big government/small government)	16	19	26	20	19	3.07	100
Technology (IT, construction materials and technology, etc.)	1	8	17	39	36	4.00	101
Social/Demographics (population shifts, immigration, aging, etc.)	9	14	23	19	37	3.60	102

As a result of the survey, considerable focus was placed on Infrastructure and Natural Resources. With regard to Infrastructure, it was established that deferred maintenance, aging and impending failure are all very real circumstances today. As a result, an emphasis was placed on future funding of projects. Infrastructure funding was given in-depth scenario planning treatment at the Crystal Ball meeting.. An overview of the process and the resulting scenarios are presented later in this document.

The emphasis for Natural Resources was on dwindling supply in the face of increasing demand and natural resources as a driver of the economy. The discussion on Social/Demographic factors yielded a surprisingly large number of trends, many of which surfaced repeatedly, and seemed to be accompanied by some degree of urgency.

Following the “Brainstorming Session,” trends were looked at in terms of how relevant they are to the long-term future of our profession. Trends chosen as most relevant are in green on the following pages. Relevant trends were then separated into either those whose outcomes are *Certain*, and don’t rely on a chain of events, or those that are highly *Uncertain*, and might alter fundamental assumptions that we make about our businesses. Uncertain trends lend themselves to scenario planning whereas strategies addressing Certain trends are generally much more evident or straightforward.

Finally, the relevant trends were viewed as either a “Headwind” or a “Tailwind,” depending on whether they would help or hurt our profession and businesses if we were to do nothing to address them. Following are the trends that were identified:

TRENDS

Trend ¹	Certain/ Uncertain	Headwind/ Tailwind
Change in ownership of firms – more multi-national, may fragment the industry	U	←
Change in funding – from banks to who knows what? Less western-centric	C	←
Financial shock – another one coming	U	←
Moving to next generation of managers / engineers – will encounter different struggles with ownership & leadership transitions than we have in the past, we are missing a generation in some places	C	←
Technology – the way we get things done is changing, contractors are more innovative than consultants, consultants may be getting left behind	C	←→
Resource scarcity may cause some surprising moves - e.g., a mining company locks up water rights before mineral rights because water is the limiting factor for mine development		
Groundwater is an unsustainable water supply; need to change focus to surface water development	C	→
Surface water capacity is declining due to sedimentation of old reservoirs and a failure to build new capacity because of “anti-dam” sentiment		
Food shortage and security will become a bigger issue (related to water shortage)		
Acute water shortages will occur in new places – Kenya, India, etc.		
Climate change will increase the variability of rainfall, driving the need for more storage in larger reservoirs and other changes in infrastructure	C	→
Water issues will affect many other regions of the world before they will affect the USA	C	→
Social media will be a business, communication, and branding driver; viral promotion (and demotion) of your brand may occur	C	←→
Corporate social responsibility and purpose-driven organizations will be key attractors for younger generations of employees	C	←→
Employees that have become unhappy but stayed put during the economic downturn will leave in large numbers as the economy improves, especially the GenX and GenY generations	C	←

¹ Trends in green were identified as the most important

Trend ¹	Certain/ Uncertain	Headwind/ Tailwind
Work force demographics are changing - next generation of leaders in western nations is declining in numbers while growing population of English-speaking workers is available from Brazil, Russia, India, China	U	←
The world is flat and wide - technology is leveling the playing field, new generations are much more globally connected	C	→
Generational shifts change the work place - from long-term employment to shorter, from loyalty to your employer to loyalty to your personal network, increase in connectivity changes how we communicate, motivated more by learning than by money, “the office” takes on a different role and purpose	C	←
Work model changing - large pensions not sustainable, more flexible work hours (“work week” goes away), definition of an “employee” is changing	C	←
Continued consolidation of the industry through mergers and acquisitions	C	←→
Growth of emerging economies (Brazil, Russia, India, China) creating a middle class where there wasn’t one before	C	→
Religions of the world drive different perspectives, politics, priorities – create tension, political conflict, instability (economic impact)		
Inequity of tax payers – who pays? how much tax base will we have? how will it be distributed?		
Energy uncertainty - need to replace fossil fuels, there is a new flavor of green (or not so green) energy every day	U	→
Moving from industrial age to information age - what will be driving business next?	C	→
People don’t want to spend public money – pressure to vote down funding	U	←
Energy security - impact of political instability in oil producing areas on production	C	←
Move toward user-based fee systems for public infrastructure	U	→
USA losing its “sole superpower” status		
Cloud computing changing how businesses run – easier to compete globally, move to more mobile technology	C	→

Scenario Planning is a tool that can be used to create strategies for trends that present an uncertain outcome or impact on our profession. The general concept is that you create endpoints for two uncertain but highly relevant trends, and play out all scenarios that are created by the interplay of the two trends. In this way, a firm can be ready for any combination of outcomes.

For our exercise, we looked at:

- The Economy – Bust versus Boom, and
- Infrastructure Funding – No Funds versus Abundant Funds

Four scenarios grew from the two uncertain trends, and regardless of how seemingly implausible each appeared, a set of circumstances was assembled that could, by our evaluation, cause that particular scenario to actually take place. Next, each scenario was looked at to determine what was likely to be happening in the areas and economies that were affected by the circumstances creating the scenario. That is, “Who is doing what?” and “What is going on?” Then, we set out to understand the likely impacts, of both the circumstances and the general reaction of the public at large, on important stakeholders and on our firm(s). Once a scenario was fully understood (including impacts and the resultant threats and opportunities) strategies can be created to take advantage of, or safeguard against those impacts and causative events.

The following four scenarios present the work done for infrastructure funding in an uncertain economy.

SCENARIOS

from ASFE's Emerging Issues and Trends Committee
2011 Scenario Planning Workshop

How do you define scenarios?

EXAMPLE

US Economy	Boom	Boom economy with strong investment	Boom economy with little investment
	Bust	Bust economy with Strong investment	Bust economy with little investment
		Strong	Weak

Infrastructure Investment

Apocalypse WOW!

Bust Economy and Weak Infrastructure Investment

This is the year 2020, the economy has not recovered since the bust in 2008; it only became worse. Poor governance, political partisanship, and legislative stand-offs lead to entitlements increasing to 80% of the national budget. The incompetence of politicians resulted in inadequate financial regulations, providing investment bankers with another opportunity to act with impunity. In particular hedge funds resulted in significant increases in food prices and hardship to many. Additionally, an energy crisis similar to what was experienced in the 1970's developed, resulting in gasoline prices increasing to \$8/gallon. The US Dollar experienced significant depreciation. This led to significant stagflation, with prices increasing by 20% per year while incomes remained fixed. Interest rates increased to 20% and consumer credit reduced to insignificant levels. This led to consumers not having the ability to purchase products, resulting in poor business conditions. Because the United States defaulted on their loans, poor relationships developed between China and the United States. Since this difficult situation developed no money for infrastructure development or maintenance is available.

Conditions in Government remain poor, with a lot of talk and little action in Washington DC. There is an absolute lack of accountability resulting in worsening of the current situation. The under-employment and unemployment rate remains high at 30%, with the crime rate having increased significantly. A large number of defaults and bankruptcies are the norm. The significant increase in interest rates, making finances very expensive, prevents clients from investing in infrastructure. The Government experiences significant reductions in tax income and are not spending money either.

Companies, including engineering and client firms, are merely surviving and recent graduates are frustrated due to the unavailability of job opportunities. Only innovative companies that have demonstrated that they can add significant value to their clients survive, and a few even prosper. Some of the innovative ideas for funding infrastructure include bartering, sweat equity, private equity, user fees, a shift from public to private funding and sale of government assets.

This situation resulted in various opportunities and threats to engineering companies. Opportunities include:

- Developing projects through assisting clients to find funding
- Hiring and retaining quality staff laid off by less successful companies
- Increased market shares as weaker firms struggle
- Boutique firms are successful

Threats to be dealt with by most engineering firms include:

- Many companies go out of business
- Very low growth is the norm
- Profits are low, with many firms having to deal with losses

- Clients award contracts on the basis of price competition. Qualifications-based selection appears to be something of the past.

The successful firms implemented a number of strategies in anticipation of the crisis, including the following:

- With the knowledge that their staff is their most valuable resource, the companies that are currently successful developed good relationships with their staff. This included involving them in planning for the worst case economic scenario, which evidently arrived. They ensured that their staff knew that they were important and critical to the company's success, that the company valued them, and that the company has a plan to deal with adverse economic conditions.
- The companies spent time defining their mission and goals, and shared this in an inspiring and positive manner with their employees. Those companies clearly know who they are.
- Having defined who they are, the companies identified the most robust markets that they could serve. Such markets were deemed least affected by the exceptionally poor economic conditions we are currently experiencing.
- Based on this knowledge, the successful companies positioned themselves to serve those markets and selected preferred clients. They fostered good relationships with those clients, which served them well once economic conditions became really bad.
- In order to prepare themselves in advance for poor economic conditions, the most successful companies identified leading economic indicators and monitored those to predict how the market will likely behave. Through this procedure they were able to predict several months ahead of time that economic conditions would deteriorate. This allowed them to communicate with their clients in advance and ensure that they were awarded upcoming contracts, well in advance of the economic crisis.

The Roaring 20's

Boom Economy with Strong Infrastructure Investment

Its 2020, the world economy is booming and the United States economy has taken off in the last 12 months. After significant strife during the previous decade, the world is at finally at peace.

In early 2013, Saudi Arabia collapsed along with a number of other Middle Eastern countries. This created significant tension in the region and forced gas prices to record levels. This situation was further exacerbated by droughts in various regions throughout the world. Food and water shortages along with high energy prices caused flare-ups across the world. Finally in late 2014, war broke out in the Middle East and it spread to Central and Eastern Europe. For a variety of reasons, the war spread to India and the Far East. Ethnic and religious tensions throughout the world rose to a boiling point and exploded when water and food shortages expanded around the globe. While not as devastating as the first two World Wars this war extended across many regions of the world.

In 2017, the United Nations and the countries of the world realizing the devastating impacts the war was creating, signed treaties and agreed to focus their energies on working together to save the planet after a huge volcanic eruption and subsequent earthquake and tsunami killed up to 1MM people in Indonesia.

In the United States, we experienced a few major terrorist attacks during the war as well as a significant uprising in Texas and California over immigration, food and water which resulted in significant property damage and loss of life along the border with Mexico.

In the 2016 elections, the people of the United States finally fed up with career politicians, elected an Engineer as the President of the United States and elected numerous significant leaders to Congress. The new leadership realized the need for fixing the government and both improving our infrastructure as well as helping our citizens to be successful. Congress changed the tax code and focused on helping companies to be competitive. Many regulations and requirements were relaxed due to the war and Congress realized after the war that the country did not suffer from the reduction in regulations. The Government and private industry worked very closely together to help the United States ramp up for the war. Both parties realized that taking care of employees was paramount to increasing productivity during the war due to shortage of working age people. They also realized for the US to survive the war we had to be at our best and most productive.

After the war ended, many regulations were repealed. Tax levels were lowered to spur economic growth, but tax revenues were significant because of the robust economy. The government along with private industry helped realign many of the third rail issues like social security, medicare and healthcare. While painful, the end of the war and the reprioritization of funds allowed for significant infrastructure development. The war wiped out industries and agriculture in many parts of the world and the United States and Canada who were least impacted by the war stepped into to supply food for the world along with other services and materials to help rebuild. This resulted in a booming economy in the later part of the decade.

Significant immigration into the country took place during the second half of the decade due to people trying to avoid the war in other parts of the world. Population in the major cities across the country increased dramatically as family of people who have immigrated over the last 30 years joined them in the United States. Agricultural areas are also successful as we struggle to feed the world. Infrastructure demand in many areas is pushed to the limit. Our economy is booming similar to the 1920's or 1950's.

In 2020, unemployment is at historic lows. The workforce is at full unemployment and many of the people that retired or left the workforce in the great recession of 2009-2014 reenter the workforce. Demand for staff is high while supply is very low. Demand for infrastructure projects both domestic and abroad is significant. Owners and their project teams are struggling to get key projects delivered and the best companies are being selected to help get these key projects completed.

Staff are leaving many firms to go and work for the best firms as the best firms are able to leverage their relationships with the best clients and their significant talent pool to be highly productive and successful during the boom. The best firms are getting more work done with less people through the significant use of technology and are significantly profitable because of it. Bonuses at the best firms are higher than any other time in our lifetime.

Engineers are leading teams because of their ability to get projects done and are being selected by the clients based on value and experience not on price. Technology is changing rapidly and those firms that were leading in technology and development of their staff have a huge competitive advantage as the market heats up.

Staff continue to migrate from unprepared firms to firms that had a purpose driven organization that were seen as leaders in helping their communities overcome the significant impact of the war. The successful firms continued to purchase the firms that struggled to keep up with the pace of the economy in order to satisfy their clients.

Whats happening? Whats going on? Who is doing what?

- Low unemployment, wages increasing
- More discretionary spending
- Shortage of employees
- Lots of big projects going on.
- Trade barriers dropped, free immigration.
- Peace time
- Social cost issues have been solved. Healthcare

Firm Implications

- Staffing challenges. Turnover. Stress.
- World War III on talent.
- Diversify, innovate, take more risk, buy other firms and talent.
- More international work with key clients

- Spread out workforce, plenty of technology to support.
- Firms investing in technology vs facilities.
- Getting into other services, products, taking over infrastructure.

Strategies to take now.

- Buy firms
- Create best in class college and high school outreach program
- Invest in technology so we can be a diverse global business
- Employer of choice, socially responsible employer to position ourselves to hire the new generation
- Structure firm to deliver in that model
- Move from T&M to value pricing. Choose where we can be most profitable.
- Programs to develop and grow our people.
- Get your capital structure prepared for growth, leverage yourself to reap benefits of rising prices.
- Be aggressive in hiring and acquiring talent. Invest and position in growth.
- Look for the best opportunities in what we do.
- Choose clients with the best opportunities
- Get closer to the money.

The Night the Lights Went Out in Georgia

Bust Economy, Strong Infrastructure Investment

By the beginning of 2020, the economic crisis of the previous decade is still lingering, and the economy is still limping along. The outrageous spending habits of local, State and Federal government had been under attack for several years, and the general population's appetite for new taxes or fees is non-existent. Cost cuts caused spending on improvements to infrastructure to remain minimal and insufficient – unable to keep up with deterioration. During those ten years leading up to February, 2020, the nation was periodically, but with increasing frequency, inconvenienced by failures to its infrastructure. Between 2017 and 2020, the occurrence and magnitude of the failures caught the public's attention following collapse of a half dozen bridges, with as many fatalities, including some along major commuter routes in Baltimore, Cincinnati, Houston and the San Francisco Bay Area. Over 70 miles of levee failed, flooding 11 metropolitan areas along the middle and lower Mississippi River, 1,100 miles of interstate were taken out of service, some for months, due to mine collapse, landslide, and general lack of maintenance, and drinking water was severely rationed in over two dozen metropolitan areas as a result of failed distribution facilities, releases from failed wastewater treatment plants, and mismanaged and depleted storage facilities.

After three years of enduring the impacts, from severe inconvenience and degradation of the standard of living, interruptions to commerce and, in too many instances, severe injury and death, the public was quickly growing intolerant. After a holiday season in which travelers were stranded and delayed at Midwestern and Eastern airports, tolerance on one edge, a massive and prolonged winter storm hit the northeast. On the fourth day of the 18 day event, accumulated snow and ice began to wreak havoc on the Northeast Power Grid, ultimately causing complete failure. The cascading effect on adjacent grids quickly caused the outage to shut down the northern three quarters of eastern seaboard and sporadically spread to more westerly states in the Eastern Interconnect. In all, 21 states and the District of Columbia were without power for 10 days. Twelve additional states repeatedly lost power for up to a day at a time. The complete disruption of day-to-day life included closing of grocery stores, gas stations, hotels, and businesses. Communications were lost including cell phones, television and the internet. Inability to effectively provide safety services, and limited capacity in hospitals resulted in threats to health and, in too many instances, death. Ultimately, prolonged closure of major market exchanges, including Wall Street and the CBOE, threatened to cause severe damage, if not collapse of the already anemic American markets.

Social outrage finally began to capture the attention of the country's leaders, and the realization that the US was going to further lose ground in its position and stature within the global economy prompted a change in thinking. In this environment of unrest and turmoil, there was an overwhelming demand for a change in priorities of government spending, with a renewed focus on funding for public infrastructure. Tax revenues were redirected from the department of defense and social welfare programs, regulations were quickly passed that smoothed the use of private and foreign investment dollars, and "sanity" was introduced into the permitting process. A massive amount of capital became immediately available for infrastructure projects, but the public entities are under pressure, edgy, and

forced to make relatively quick and decisive decisions, placing a vast majority of the process into the hands of the engineering community.

All-in-all, the great sense of urgency created real demand for engineering services, and ASFE member firms are generally well positioned to take advantage of this demand. The sheer magnitude of much of the work pushed larger firms into a better position to win projects, but smaller firms found ample opportunity under teaming arrangements or Joint Ventures. Engineers are suddenly in very high demand, and competition for the available talent is driving salaries up quickly. Civil Engineering is, literally overnight, thrust into a prestigious and powerful seat.

Firms that thrived, particularly immediately following the initial failures and the triggering event, including those with a robust disaster response plan that included a strong communication plan, effective backup systems, solid work from home strategies, and a means for stability for the employees and their families.

Strategies that successful firms employed for the long term included:

- Pre-disaster research and a strong understanding of infrastructure needs including area infrastructure that is weakened and sub-par, as well as an understanding of what will be needed in the longer term;
- A decade (at least) of developing and maintaining relationships with infrastructure clients and teaming partners;
- A strong understanding of funding mechanisms, and developed relationships with potential investors;
- Positioned senior personnel to have a more strategic voice in the planning and direction of infrastructure projects;
- A decade's worth of education (for infrastructure owners) in the need for quality in the design, construction and maintenance of these projects.

The Tea Party Twilight Zone

Boom Economy, Weak Infrastructure Investment

Dateline 2020. The United States is caught in a quandary. The US and global economies are booming and jobs are being created in the private sector. As business increased, demands for exports from the world's emerging economies are overwhelming existing infrastructure. Deterioration in road conditions and congestion due to limited capacity that has not kept up with demand, are taking their toll on the service level provided by existing infrastructure facilities. Maintenance activities and expansion of existing facilities are delayed due to lack of public funding. Angry tax payers who are convinced that they are being "Taxed Enough Already" have gained sufficient strength to vote down any new increases in public funding for infrastructure improvements.

The past 9 years have seen the most dramatic change in American politics in the history of the United States. In 2011 the rise of the TEA party candidates finally reached a critical mass and started to control elections at the local and school board level. The national and statewide elections in 2012 had record numbers of incumbent politicians thrown out of office but with Barack Obama winning re-election at the top of the ticket, the democrats were able to keep a razor thin control of Washington. Spending during the 4 years from 2012 to 2016 was prioritized to causes controlled by public unions. Government borrowing continued at record levels and the money was primarily directed by the federal government to reimburse local and state governments for the revenue shortfalls that the TEA party loyalists had been inflicting at those levels. Preservation of public employee retirement benefits and free healthcare for those employees consumed the bulk of the federal monies, leaving nothing for capital projects on the local level. With the TEA party firmly in control at the local level, income and property taxes were not increased to fund the growing infrastructure needs.

The elections of 2016 completed the transition in American politics from a 2-party system with the addition of a 3rd party, led by Sarah Palin in the presidential race. With Ms. Palin's sweep of nearly all of the electoral votes (except Alaska), along with TEA party control of the Senate and House, government budgets at both the local and federal levels were cut for 3 years in a row (2017 to 2020) for the first time in US history. Due to the extensive borrowing in the 5 years preceding President Palin's election, the federal budget now consists of 3 categories of spending; interest payments and principal reduction of the national debt, social programs, and the military (albeit at only 50%) of the levels in the Bush administration. The education and energy departments have been eliminated along with all funding that had previously been used by those agencies to initiate new strategies. The transportation fund revenue has been dropping for the past 5 years due to the massive numbers of employees in the private sector working from home based offices. This reduction in revenue has stalled 60% of all capital spending for transportation improvement projects.

- Tax payers are upset and demanding that "pay as you go" and user fees be used instead of income or property taxes being paid by a select portion of the population.
 - 1950/60s funding mechanisms have been corrupted by the current political power and this change in the political system is a reaction.
- Economic activity is increasing demand on existing infrastructure but the lack of public funding is preventing upgrades or maintenance.
- Employers are moving locations because of poor service, red tape and lack of infrastructure investment. Employers are also changing strategies to minimize impact on operations

(e.g. Transportation companies are creating inland ports and moving containers by rail for truck distribution).

- ASFE firms are adversely affected by the lack of public funding. Small firms have to take drastic actions to survive. Regional and National firms have to cross train staff, change course or move into new markets and service areas.
- Staff of ASFE member firms may have to move because firms are consolidating offices.
 - Employees are leaving firms due to lack of opportunity
 - No bonuses - lower wages
- Clients
 - Moving to other locations (poor roads, lack of services)
 - Changing strategies (ex. Moving to new ports)
- Private funding is available, but due lack for certainty of future pay back and increased risks of default, investors are demanding high interest rates for government bonds. Money will follow opportunities in the private sector.
- Angry tax payers refuse to “kick the can” to future generations to pay the bills in the future for current infrastructure improvements.

The lack of public funding will impact all stakeholders in different ways.

- Although firms will continue to preach Quality Based Selections, ASFE member firms will eventually make business decisions and compete on price to survive and fight another day.
- Tax payers are angry and asking public agencies to spend within their current means. Privatization will be inevitable to increase efficiency and effectiveness of public facilities. This will lead to conflicts as angry taxpayers will attempt to fire public employees or reduce their benefits
 - May be an opportunity here for ASFE firms
- Public agencies will continue to borrow from the future which is unsustainable.
- Member firms will consider their options to deal with the lack of public funding:
 - sell firm or downsize
 - change disciplines or industries
 - change skills or cross train staff
 - move from traditional geotechnical services to design
- Although social responsibility is considered by many ASFE firms as a core value, member firms will revert back to survival mode and ignore this responsibility.
 - Some talent will leave firms as result.