Engineering Analysis and Management to Reduce Risks

CONCLUSIONS

Engineering Analysis and Management to Reduce Risks

Convocation statistics

The 19th CAETS Convocation was held in Mexico City from June 27 to July 1, 2011. Three keynote conferences and 21 papers from 11 countries dealt with the topic of Engineering Analysis and Management to Reduce Risks, of which a succinct conclusion is presented in this document.

Unsung heroes

Risk prevention has much less allure than after-the-fact actions, which are more visible and dramatic. There are no recognitions for those who work on reducing the probability or the impact of risk events, while there is many times more applause for heroic efforts to contain damages or rebuild what was destroyed.

Many risks prevention and mitigation actions fall in the decision-making realm of politicians, who naturally aim for public presence and recognition, and thus find little attraction to the limelight of such decisions and actions. As a result, in many cases risk events cause much more damage than otherwise, if proper and timely preventive actions had been taken. However, these cases are not always publicly recognized as a lack of planning, and even in cases when they are, public pressure for remediation is more often than not outlived by the period of uneventfulness between catastrophic events of similar nature.

Five areas of concern

The 19th Convocation conclusions can be grouped in five main areas of concern:

- The limited influence of engineers in risk prevention
- The importance of proper planning to mitigate risk
- The necessity to recognize that systems are coupled, either strongly or weakly
- There are many opportunities for innovation in risk assessment and prevention
- There is a strong knowledge base that should be exploited to improve risk assessment and prevention techniques.

Each of these areas of concern is further described below.

The limited influence of engineers in risk prevention

Engineers are often credited for their endeavor to quantify physical-chemical phenomena, that is, to think and express themselves largely in terms of physics, chemistry and mathematics, mostly in an objective and maybe a little detached way. On the other hand, most people are motivated by sympathy and the promise of happiness -the sooner, the better.

Thus, as engineers present rational predictions from the facts that they can obtain, often find a "wall of denial", which is a natural human response to undesired (unhappy) scenarios. This happens also because the engineers' propositions are not always credible, either because they are not always solid and irrefutable -after all, there are many phenomena that cannot yet be explained - or because after-the-fact analysis of previous phenomena often bring to surface weaknesses on the systems that were not anticipated by their designers, either because of limited analysis, plain disregard for best engineering practices or budgetary restrictions, that nobody remembers.

Studying the vulnerability of complex systems is many times considered an unnecessary expense, instead of a worthwhile investment, and going through the learning curve is many times considered too slow for the political schedule and agenda. The perceived necessity to make such studies is also hindered by the short memory of disasters and the political gain equations: people tend to forget all too soon unhappy events, and so we find that they live next to active volcanoes,

moody rivers or at the base of dam curtains; politicians, on the other hand, find more gain from playing to the sympathies generated by disastrous events than from the unheralded prevention of them.

Engineers need to develop some sort of technical-to-sociopolitical interfacing that puts information in terms that are best understood by decision makers, in order to help them to more effectively attend to their obligation to guarantee the welfare of the people. In this sense, Engineering Academies could establish an internal body dedicated to support and lobby in favor of engineering proposals so that they are presented in a manner that should have a higher probability of success.

The importance of proper planning to mitigate risk

Eisenhower's is quoted: "Plans are nothing; planning is everything". There is no substitute for planning in the prevention of impending risk consequences or in the diversion of probable risk circumstances, particularly because of the often tremendous impact of some of these events, that take an enormous toll and a long time to recover in many aspects: environmentally, economically and psychologically.

Long term planning must consider that technology is never still and will change from its offerings at the time of planning. Tools like Technological Road Mapping may be very useful during such planning.

Long term planning for risk assessment and prevention can profit tremendously by feeding back to the education of the population and specially children, since people's education and attitude towards risk is a very powerful prevention tool.

The necessity to recognize that systems are coupled, either strongly or weakly

It must be widely recognized that systems interact, that they are coupled, some weakly and some strongly.

Some risk-systems can be affected indirectly through actions that modify other systems that are coupled, thus producing a *chain reaction*. Analysis of higher than expected frequency of High-impact/Low-probability are being explained by their coupling to other systems that provide a stimulus.

Decisions or their absence therein, that fails to consider this coupling, hinder sustainability, increase risk and the cost of after-the-fact remediation.

Engineers must take advantage of current technological tools that allow modeling and analysis of more complex, coupled systems, to understand them more thoroughly and to illustrate possible disastrous outcomes.

Many opportunities for innovation in risk assessment and prevention

There are several opportunities for innovation in risk assessment and prevention, as are concepts like vulnerability and resilience, or the application of techniques used in nuclear industry, like health monitoring and redundancy, that should be used more widely to an advantage. Also, one can take new approaches to model the non-linear response of some systems to stimuli, or use of fuzzy logic to deal with inter-system coupling.

Efficiency can be a mitigating factor for energy and food related risks.

New structure building technology to resist seismic events is another example of areas where innovation is welcome.

Take advantage of current knowledge base

There is a strong knowledge base that should be exploited to improve risk assessment and prevention techniques. Several tools have been developed by engineers in different countries, and they are available to their colleagues to reinforce their tool box. These experts are also available to talk with us and provide us with guidance in their field of work.

Communications among CAETS member academies is a very powerful tool that we should take full advantage of.