



SOCIETY OF ACTUARIES

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Environmental cont'd

tional funding must come from a broadened tax base, private industry, insurers, or other sources.

Insurers often are reluctant to provide clean-up and liability coverage because of broad court interpretation of insurance contracts. Any costs borne by insurance companies are passed to insurance purchasers, who in turn pass costs to consumers. Consumers also bear the cost of any increase in direct clean-up costs or taxes paid by private industry. Consumers can be tapped more directly by "user" fees and taxes that go directly into clean-up funds. As an example of the last item, an additional tax on gasoline could go toward the clean-up of underground petroleum tanks.

Another method of broadening the tax base is to increase the general tax revenue. Who is impacted by this approach depends on the tax law at the time the increase is established.

Substance abuse — Smoking is one of the largest health hazards to the general population. This is particularly distressing considering that to smoke or not is each individual's decision. Smokers have higher health costs, die younger, and cause or exacerbate health problems in those around them. Also they spend money on cigarettes that could be spent in more productive ways, and they cause additional cleaning expenses for removal of smoke odors from such items as clothing and drapes.

Some of the smokers' additional costs are paid by the smokers. Others are borne by those surrounded by smokers. Many are paid through taxes that fund health insurance programs such as Medicaid. Abusers of substances other than tobacco have similar costs, many of which are not paid by the substance abuser.

Prevention and reduction

To date, most environmental risk activities have focused on the clean-up of current environmental problems. Many of these problems are immediate in nature. But to benefit long term, action should be taken to prevent these problems in the future and to reduce the impact of those that occur.

The ultimate prevention is avoidance. The best example of solving an environmental problem through avoidance would be for everyone to stop smoking. This might cause some short-term economic problems for

tobacco growers, manufacturers and distributors of tobacco products, and their employees. However, the long-term economic and health benefits of avoidance far outweigh the short-term economic problems.

Many environmental risks can be reduced. Often a problem chemical can be replaced with one that does not cause a problem, or the procedure utilizing it can be replaced with an entirely different, and safer, procedure.

For those environmental risks that can not be reduced, we might be able to mitigate the impact of problems that arise. For example, if there is no other option than to store a petroleum product in a tank, the tank could be placed above ground and monitored frequently to reduce the time between leak occurrence and discovery. Clean-up procedures can be improved and practiced so that discovery of a leak triggers immediate and effective action.

Summary

Properly managing environmental risks, rather than simply responding to crises and/or passively estimating costs, is important to our survival as a species and to our quality of life. Rather than simply estimate the financial implication, actuaries can be active in making informed choices. This requires that the following activities be performed:

- determine to the extent possible the full range of possible environmental risk problems,
- consider all realistic alternatives including prevention and reduction,
- estimate both the direct and indirect financial and nonfinancial impacts of each alternative,
- consider the expected cost and range of costs when looking at the financial impacts,
- consider who will ultimately pay the associated costs and the best way to accomplish this, and
- make an informed decision.

The results of the decision should be monitored to see if the decision is producing the expected results. If not, the decision may need to be altered to better meet humanity's long-term needs.

Margaret Wilkinson Tiller is President, Tiller Consulting Group, Inc. She was one of two actuaries who spoke at the Forecast 2000 Environmental Risk Forum in Toronto in July.

Captain Gerald Coffee says, 'Faith is the key to survival'

by Judith Bluder

With a recount of the seven years he spent as a prisoner of war (POW) in North Vietnam, Captain Gerald Coffee, a retired naval officer, delivered a message on faith at the Society's annual meeting October 22-25 in New York City.

His keynote presentation focused on the invincibility of the human spirit. Coffee told of how he learned to stay alive and sane in a situation that seemed hopeless. He described the seven years he spent jailed in a cell the size of a large closet with a concrete slab for a bed, and the beatings and mental fatigue he had to endure.

Although those years in Vietnam seemed futile, Coffee said he learned some valuable lessons the hard way. But now he is able to share those experiences and hopes to inspire people to believe in themselves, he said.

"It didn't take very long to figure out that probably the very key to my survival all those years in prison was going to serve me just as well as the key to survival right here at home on a daily basis for the rest of my life," Coffee said. "And the key was simply faith."

He said that without past experiences to draw upon, making decisions and living in a world so full of ambiguity and gray areas would be that much tougher. If his experience as a POW inspires others to have faith in themselves, their country and people in general, Coffee said he has accomplished his goal.

The faith that pulled him through the years of solitude, torture and mental anguish consists of four different aspects: faith in ourselves, in one another, in our country and in God.

In Vietnam, Coffee said he and the other POWs had to find "faith in ourselves to not just survive the experience, but to go beyond survival. To survive and return with honor."

The POWs, each locked in individual cells, communicated with tapping, coughing and sneezing.

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Proof that $1 = -1$ using Makeham's Law

by Douglas A. Eckley

It is well known in actuarial circles that $1 = -1$, but rigorous proof of this deceptively simple equality has seldom been attempted. A proof using Makeham's Law of mortality is presented in hopes of stimulating discussion.

Makeham's Law can be written $\mu_x = A + Bc^x$. Note that, mathematically, negative ages are as valid as positive ages. This leads one to write:

$$\textcircled{1} \quad 1 = -1 - \frac{2(C^{40} - C^{39})}{C^{79}(C^{-40} - C^{-39})} = -1 - \frac{2(\mu_{40} - \mu_{39})}{B}$$

A useful property of Makeham's Law is that a joint life status consisting of any two ages is equivalent to a joint life status with equal ages. The equal age is somewhere between the original ages. Assume a Makeham table has been constructed so that $\bar{A}_{41:41} = \bar{A}_{40:42}$. This implies that:

$$\textcircled{2} \quad \mu_{41+t} + \mu_{41+t} = \mu_{40+t} + \mu_{42+t}$$

For the proof, proceed as follows:

$$\frac{C^{40}}{C^{39}} = \frac{C^{41}}{C^{40}}$$

$$\frac{\mu_{40} - A}{\mu_{39} - A} = \frac{\mu_{41} - A}{\mu_{40} - A}$$

$$(\mu_{40} - A)^2 = (\mu_{39} - A)(\mu_{41} - A)$$

$$\mu_{40}^2 - 2A\mu_{40} + A^2 = \mu_{39}\mu_{41} - A\mu_{39} - A\mu_{41} + A^2$$

$$\mu_{40}^2 = A(\mu_{40} + \mu_{40}) + \mu_{39}\mu_{41} - A(\mu_{39} + \mu_{41})$$

$$\mu_{40}^2 = \mu_{39}\mu_{41} \text{ (using } \textcircled{2} \text{ with } t = -1)$$

$$\mu_{40}^2 = \mu_{39}(2\mu_{40} - \mu_{39}) \text{ (again using } \textcircled{2} \text{ with } t = -1)$$

$$\mu_{39}^2 - 2\mu_{39}\mu_{40} + \mu_{40}^2 = 0$$

$$(\mu_{39} - \mu_{40})^2 = 0$$

$$\mu_{39} = \mu_{40}$$

$$1 = -1 \text{ (by substitution into } \textcircled{1})$$

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Coffee cont'd

Instead of allowing the Vietnamese to get the best of them, Coffee said the POWs continued to follow the American Fighting Man's Code of Conduct to the best of their ability, even though they were ordered not to follow those rules. They tapped messages to each other on their cell walls and learned foreign languages and even poetry through that method.

Poetry brought new meaning to their circumstance, Coffee said, because of the beauty and strength it provided. "We locked onto the verse in the poem, 'If,' that says, 'If you can force your heart and nerve and sinew to serve their term long after they are gone and yet hold on when there is nothing left within you except the will that says to them hold on, hold on.'"

Coffee cited volunteerism and leadership as an example of "faith in ourselves," and said the Society is a perfect example of both.

The second aspect of faith, faith in one another, also is of great importance. "Our motto there in the prison system was very simple," Coffee said. "Unity over self. (That's) not a bad corporate motto or association motto." He said strength lies in unity and togetherness, and that is why the Viet-

namese kept the POWs separated in isolation. "We weren't allowed to communicate with each other and if you're caught communicating with another American, you're punished severely. But we communicated all the time anyway."

Coffee asked why people now make communicating so much more difficult than it needs to be. "We don't have to tap on the walls from the bedroom to the kitchen, or from office to office in our workplaces," he said. "(We need) faith in one another professionally, really believing that every other man or woman is doing his or her best to maintain the same standards of professionalism, quality, dedication that have seen your profession through a hundred years now."

The Vietnamese made the third aspect of faith, faith in your country, a bit difficult to follow, Coffee said. Every day while he was kept prisoner, he was forced to listen to everything that was bad about the United States through loudspeakers located in each cell. "And I'll tell you, after four, five, six years of that overwhelming wave of negative propaganda about our country and our cause, you'd have to say to yourself, 'Wait a minute, don't believe that junk. You're an American,

you've lived there, that's your home. This isn't the place to change your mind, dummy. Keep faith."

The final aspect of faith, faith in God, is possibly the foundation for it all, Coffee said. When first imprisoned, he found two English words scratched on the wall of his cell: God = strength. "I was never, ever totally alone," he said. "I could always find just a little bit more strength when I needed it."

Upon his return to the United States in 1973, Coffee said he was overwhelmed by the greeting he received from friends as well as strangers. They told him how proud they were of his patriotism. He told his audience they should feel proud because they had a part somehow in the outcome of Coffee's return and the spirit that helped guide him through his experience. That's because, he said, "We are so much alike. I'm from you, you know, we are all the same clay and spirit, we derive our strengths from the very same sources. All those years the Vietnamese tried to break our spirit, our confidence, our faith and they couldn't do it. And the reason that they couldn't (is because) in great part right here before me today, truly every one of you."