# SENSO-DO

# THE WAY OF THE PROFESSIONAL

**Author**

**A J Rowe**
Senior Technologist : AEL

Paper to be read by: C Conradie AEL

## ABSTRACT

The talk discusses the issues of Good Explosives Practice and its interrelationships with all the aspects of the explosives business. Actual events highlighting poor industry practices are presented and a practical way forward is presented.

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**By**

**A J Rowe**
**Senior Technologist : AEL**

There is nothing in the following talk that is new. There is nothing that is particularly revolutionary. There is probably nothing that you have not heard before either. What may be different is the single dose prescription.

This is not exciting stuff so like any nasty medicine the best approach is to get it all down in one go. No drawn out suffering and it's over pretty quickly.

There is a phrase often heard at Modderfontein. There are perhaps a few technical variants and other cultural subtleties, but the meaning remains essentially the same. This phrase, stripped to its bare essentials blandly states:

"We don't make sweeties here"

What do we mean?

Explosives as always, are powerful agents for change, but remember, every initiation has, potentially at least, the ability to change lives forever. The Four Horsemen of the Apocalypse; namely, Death, Injury, Destruction and Grief loiter hopefully in the background of every explosives related event.

They tell me that Death rides a pale horse. Well, I'm in no hurry to find out.

So, how do we keep the Horsemen at home?

What programmes or processes are there in place?

Before I answer that I need to talk around the issues involved and how we ended up where we are.

Like most industries, the life-blood of the explosive business has traditionally been its people.
In recent years, downsizing and redundancy programmes have exacted a heavy toll. The result is that the safe operation of explosives production facilities grows increasingly harder.

Good Explosives Practice has suffered alongside. Oh! It's still part of that lifeblood, but like a cold glass of OROS, while the colour and flavour might still be recogniseable, something has changed. It's been over diluted.
Oh! It's still good if there is nothing else, but its substance is less than it was. Dilute it much more and it won't be worth the effort.

Now, to change the subject a little.
We are all taught from childhood that safety is largely a matter of common sense. No specialised knowledge is apparently required.
Our schoolteachers show us how to cross the road and our parents and friends teach us the other bits and pieces.

I mean, why would you put your hand in the fire. Everyone knows that you'll get burned. Do it once and you'll certainly hesitate before repeating the process, but must you get burned in order to learn?

Hopefully not, but what about commerce in general and industry in particular. Do we really have to be selectively crushed, scalded, partially dissolved or minced to learn how to survive? Surely just one silly mistake couldn't really be your last?
Generally one would hope not, but what about the explosives business?

I think it's true to say that the explosives industry is probably one of the safest there is. However, due entirely to the products themselves, it does, in some respects at least, tend to be a little bit different.

Mistakes involving explosives can be costly; even first mistakes.

But why trust to luck anyway? Surely there's a better way?

There is, but it doesn't come in a single package.
We, in the industry call it "Good Explosives Practice". The Way of the Professional, or in Japanese, Senso-Do.
Why Senso-Do? Simple. 'Cos it makes Good Senso-Do

I've chosen today to present it as some esoteric Eastern Philosophy and while there are similarities, especially in the areas of discipline and patience, Oriental it definitely is not.
It won't make the weak strong, the poor wealthy or the stupid suddenly brilliant.
It does demonstrably, however, save lives and one of them might be your own.

Good Explosives Practice (Senso-Do) is not something we are born with. It has to be put in, but don't panic, you don't have to be blown up, partly incinerated or even lightly toasted. No injections or shock treatments are necessary either.
Good Explosives Practice can be learned or taught and like most disciplines, some people prove inherently better at it than others.

If I asked you the question right now, when do things go wrong? What would you tell me?
I'm not going to wait for answers; I've already prepared one:

"Always when you least expect it".

"Always when you least expect it"!

Why?

People take chances.

People are unpredictable.

People make mistakes.

People forget. (In fact they forget very quickly)

There are always production and other pressures

Added up, this simply means that it is impossible to forecast what and when any particular event will happen. Oh, there are certainly omens and portents, but there is no need to sacrifice a beast or consult an oracle.
A steady rise in the number of small incidents is one reliable indicator.

When the numbers of small incidents increase then the possibility of a major incident or a fatality occurring becomes ever more likely. Concentrating on eliminating the minor incidents therefore favourably influences the latter. But be aware! Random chance alone can also lead to a temporary dip in the perceived rates. The trick is in maintaining low levels all the time.
But what if you take away the discipline, eliminate the understanding and kill off the experience? History teaches that

in such cases both the frequency and seriousness of accidents will increase.

So, Lesson one. **Safety revolves around people**.

Learning to predict and prevent chemical process hazards is part of a typical chemical engineers education. Courses on design, reaction kinetics, thermodynamics and runaway reactions teach the student about the operation of a chemical plant.
People issues are not part of the curriculum and it is people issues that lie at the heart of most incidents.

The second lesson then.

**Don't assume that new graduates know anything about safety.**

Many young managers will tell you from the safety of their laptops that they understand the basics of Good Explosives Practice, but ladies and gentlemen building a world around a series of red and green squares doesn't necessarily get the job done safely. Further, it enlightens no one about the laws of consequences.

Lesson No. 3.

**Young managers, fresh from the universities can talk the talk and sometimes even walk the walk. They can make decisions that would keep a lesser man awake at night, but a little judicious probing may reveal their basic understanding to be fragmentary and superficial.**

If you asked your plant manager with the best record of safety "Your plant processes explosives. Now, given the risks around your working environment, just how safe is your plant.

Secondly and even more specifically, how many deaths would be acceptable to you per year".
He or she will probably immediately reply "That the plant is safe and None". "No deaths" to the second question.
However, if pressed hard enough and you instructed him or her to include earthquakes, 9/11 type plane crashes, suicide bombers, vehicle accidents, heart attacks, even lightning strikes then you might eventually gain acceptance that his or her plant is not so risk-free after all.

Lesson 4.

- **Despite the best endeavours of company or management, no activity is ever entirely safe**

- **Secondly, people are risk-blind in their outlook. This means that they normally only consider the particular risks resulting from the nature of the work and do so to the exclusion of all others**.

From my own personal experience I have concluded that most incidents and accidents involving explosives result from one or more of the following factors:

- Disregard of rules
- Poor design or ergonomics
- Apathy and Ignorance
- Human error

The first factor, 'a disregard for rules' lies outside the scope of this talk, but both poor design together with apathy and ignorance are nicely bracketed. They are addressable and we will briefly touch on both.

I once asked a colleague to what is the meaning of the word “apathy”. He was reading at the time. Without even looking up he answered that he didn’t know and he couldn’t care less.

Wow! I was stunned. I’m still not sure that he understood the accuracy of his answer, but to this day I stand in awe.

We all experience or display apathy at some time in our lives. It’s a defence mechanism that people fall back onto when they feel threatened or unsure. The good news? It’s fixable.

And ignorance? What about ignorance? For a start, ignorance does not imply stupidity. It simply means “without knowledge” and knowledge is readily transferable.

Next.

Human error.

To be human is to make mistakes.

Consider that some of the most intelligent and highly trained people in the world are military and commercial pilots. Consider too, just how many times the term ‘Pilot Error” makes up part of the conclusion around an aircraft accident.
If the best can screw up, where does that leave the rest of us?
Unfortunately this talk will do nothing for our inbuilt and inherited inadequacies. Thus the vagaries of human error also lie outside the boundaries of this talk.
I should, I suppose, at this point, state my own personal conviction. I believe that all injuries are caused!
All injuries and most accidents result from either specific carelessness, poor judgement or a lack of knowledge. I don’t believe expressions such as “Shit Happens” and there is absolutely no truth in expressions such as “It was unavoidable” or “ It couldn’t be helped”.

That said. So just what is Good Explosive Practice? This Senso-Do?
Well, it's a catch-all phrase. I've seen some pretty fancy definitions, but the distilled essence is simply this.

It's a way of working safely with explosives, but it's a demanding discipline that demands a wide range of knowledge.

Unfortunately, no formalised system actually exists. What is available resembles a squatter camp, one that was cobbled together over the years and has been subjected to continuous modification ever since. Almost everyone has heard of it, but you're just not sure where it is. If you are a resident or regular visitor, then it's easier to find you're way around, but woe-betide the casual caller. The roads twist and turn, the streets don't have names, the houses are unnumbered and there are traps for the unwary.
It's not easy at all. Yet, despite all its problems, Good Explosives Practice was, is and always will be a basic requirement for all persons managing any form of explosives operations.

Why?

Good Explosives Practice aims in some part at least, to intercept or foresee potential hazards while maintaining risk free operations. The practice encompasses all operational, logistical and business aspects of the explosives environment.
In many respects 'The Good Explosives Practice' process falls somewhere in the no-mans land between a HAZOP and The Basis of Safety.

OK. So there's no streetmap, no properly documented route. Why?

Because the whole process is essentially experience driven!

Where is most of the experience? To tell you the unpalatable truth, it's either retired, suspended or being wasted on the mundane.

So. If you want the advantages of Senso-Do you can't afford to wait 10 or 20 years to absorb life's hard lessons. Osmosis is just too slow.
The answer is simply this:
You've got to get off your butt and go out and get it another way.

You have got to hit the books and surf the web. You've got to sit down with the old men of the industry. You have got to work for it and you have to want to.
It's a way of life that is entirely self-motivated. Your reward? You get to save some lives. You prevent a few heart wrenching injuries and somebody you don't even know, gets to go home tonight and play with his kids.
He won't thank you. He'll never even know. It's altruism at its ultimate.

But, if you've taken the trouble to find out, there are some advantages.

We've already established that there is no money in it. Few promotion prospects either. It won't help you pick up girls, get free booze or win on the horses, but once adopted, it automatically governs your actions wherever you might be. It's like one of these new-fangled navigation devices for cars. You know, the ones with the voice that safely navigates you through to your pre-selected destination.
The 'Street Pilot' of Good Explosives Practice works in a similar manner, guiding its practitioner through most pitfalls to safety. But don't get too complacent; it can never cater for all situations. Like an informal settlement, learning your way around is an evolutionary process. And there are always places you will never go. Maybe it's because the world is too big, too

dark, too scary or sometimes just too much. But, whatever the reason, unlike the novice, when facing the unknown, the seasoned practitioner always has strength of experience to fall back on.

For the experienced Senso-Doist, the system works equally well at home. It works when you're lighting your braai fire, mowing the grass or enjoying the pool. It's with you in the car; where you ignore it at your peril.
Good Explosives Practice also has rules, but rules are merely a framework to build around. They are always the structures of last resort. Rules have no load bearing capability and are always the first things to be broken when the pressure is on.

Subjectively I believe that safety is best promoted by persuasion and personal force of authority.

I read a book once. It was called 'The Caine Mutiny' and No! it didn't have any pictures.
In the book, the crew of the USS Caine, use the Captain's habits against him. Captain Queeg, who is a bit of a martinet, regularly inspects his ship, inflicting severe punishments against any perceived transgressor.
The crew, skilled in the complexities of survival, quickly notice that he always follows the same route. They quickly establish what the book calls, "The Circle of Compliance".
From that moment on, when Captain Queeg goes walkabout he finds only good order and discipline.
Outside the tight circle of his habit his ship is a mess. Chaos, enforced by law of the fist, governs all.

This classic story begs the question. Do you as a manager also have a 'circle of compliance'? Find out. Make a few forays into the unknown. Find out. Is there confusion all around?

So far I've rubbished what exists. I've painted a picture of an industry with a safety structure about as solid as ghost breath.

Is it really as described or is it only one persons rather deliberately cynical opinion.

- ✓ You have the power to change it!
- ✓ Everything must have a beginning.

If you do nothing you support further decline.

So:

Start today to formalise the process.

Capture - using whatever medium - the current state of knowledge.

Teach managers from the beginning to trust their instincts. If it looks or feels unsafe then it probably is.

Teach managers to accept that there are areas where their own experience may be found wanting. Teach them that this is true for everybody - nobody can know it all. In such cases train them to actively seek out and consult with persons knowledgeable in the field of particular interest.

Educate them around the values of reporting and recording ALL unusual incidents. Don't let anyone walk away from a booby-trap

Train them never to let any maintenance work to take place unless they are personally satisfied that it is safe.

Good Explosives Practice demands knowledge, but more importantly, it requires understanding.

Share what you know. Pass on the understanding.

For instance, every year, fires alone account for an incredible toll of injuries, loss of life and destruction of property. Most adults think that they understand fire and how fires start, but how many persons know that carbon bisulphide vapours can ignite upon contact with hot steam pipes or that petrol vapours can travel long distances downhill and can accumulate only to be ignited later? One such incident a few years ago killed an old lady at her kitchen stove.
How many here know that mixtures of fine aluminium and carbon tetrachloride can spontaneously detonate? I only learned of that particular reaction a few days ago, but it's out there and it's waiting. The Horsemen know it and are already saddled up awaiting the unwary!

Provide Training.

What are the most common industrial problems? Well, they'll almost certainly include tripping, falling, being hooked on protrusions or being struck by moving objects.
When did you last trip over or find yourself hooked on something?

Next.

A question. What's the difference between a fairy story and a tale of the explosives industry. The answer: a fairy story always begins "Once upon a time". A story about the industry usually starts with a loud BANG!!!

So share Relevant Information. I learned the other day that a person was severely injured while attaching an electric detonator to a length of shocktubing. To do so he had used the leadwires of the detonator as the attachment mechanism.
I have done the same thing many times.

During the wrapping process he generated an electrostatic charge whose magnitude proved sufficient to initiate the detonator. When the detonator fired he was seriously injured.
Good Explosives Practice demands that I immediately stop doing this myself. It also demands that I share this priceless gem with others.
I am continuing to do so here.

In another similar incident a man used PVC tape to fasten a detonator to a booster. An electrostatic discharge occurred. This man was killed.
Here are some other real life examples where Good Explosives Practice (Senso Do) was clearly not well applied:

Following a fatal accident in which 2 persons lost their lives, personnel attempting to recreate the event used live explosives from the very same batches as those involved in the previous days incident. If that was not bad enough they also encouraged a variety of onlookers - including most of their senior managerial staff - to congregate around the reconstruction activities to watch events as they unfolded.

A conveyor used to transport pyrotechnic material was itself manufactured from an incendive material. That material was polyacetal. Polyacetal has an ignition temperature of ca 170 degrees centigrade. During the process, pyrotechnic material had been allowed to accumulate at each end of the conveyor. A small ignition resulted in the conveyor itself catching alight. The moving conveyor became the primary source of ignition for both groups of accumulated material. As a result a relatively small incident escalated into a major event

Dampened waste sawdust from detonator rumbling machines awaiting destruction was stored in bags made from polypropylene. Closing of a bag was affected by passing a length of string through a series of eyelets stitched into the bag mouth. The eyelets were made from brass. A reaction between

the lead azide, the moisture and the brass allowed copper azide to form. When two of the eyelets subsequently impacted against one another, a detonation resulted. Sawdust was sprayed everywhere.

Please! Be aware that formation of this extremely unstable explosive can take place in hours. Under ideal conditions, detonable quantities of copper azide can form on exposed surfaces of objects manufactured from brass or copper, not in days or weeks, as suggested by much of the available literature, but during a morning.

Another one. A complex dosing machine used to prime and consolidate lead styphnate suddenly exploded. Machine guarding was very well designed and operator PPE proved effective, so aside from some new items of personal underwear, nobody suffered any injury

The machine was a temperamental device and both operators and team managers alike had learned to leave well alone. It was generally operated under the “If it ain’t broke, don’t fix it” philosophy.

Thorough cleaning was undertaken at regular intervals and these were supplemented by an additional cleaning regime every time a ‘pop’ occurred. A ’pop’ by the way is a colloquialism for a detonation occurring during processing at any particular station. There can be up to 8 of these in a shift.

I should perhaps point out that the presence of steel shielding made cleaning the deeper recesses of the machine very difficult - unless of course, the station was dismantled - something no one wished to do. When the incident occurred, the machine had been operating for over a month without a single pop. Of course powder had been accumulating in those very same deep, dark recesses where nobody chose to go. When a ‘pop’ finally did occur, it was immediately amplified, spreading out at thousands of metres per second until it reached the bulk powder, which also detonated.

Senso-Do is also part of the management's responsibility to reduce accidents.

So,

Provide Understanding

At AEL the successful management of risk relies heavily upon the application of hazard study techniques.
This is another of those catchall phrases. This particular methodology is a lot more tangible, however, and it includes risk assessments and HAZOPS - a formalised series of meetings where a group of qualified and experienced persons, skilled in the art, attempt to identify the risks and hazards associated with a particular process or facility.
But, be warned. There are some negative aspects to the use of both Risk Assessments and HAZOPs.
Any of the following can result in the quality of the study being compromised.

The first and most insidious is the perceived need or pressure "to get the job done". In such cases HAZOPs are merely another hurdle to be overcome and "The Just Get It Over With" approach prevails.

Secondly, minutes are generally confined only to those risks judged to be not acceptable. In the event of a subsequent incident there is a tendency to fault the HAZOP team members for perhaps unrecorded and therefore potentially unaddressed issues.

Thirdly, until fairly recently, management support for the HAZOP leaders themselves was generally fairly poor.

Fourthly there is currently a shortage of personnel possessing the necessary attributes, one of which is work-related experience.

And number 5. There remains a tendency to believe that if something has been HAZOPped it must be 'safe' - HAZOP quality notwithstanding.

With knowledge, all of the above are addressable. At **AEL** the appointment of a group of people known as The Godfathers, went a long way toward stabilising the situation. The Godfathers themselves are all experienced personnel of whom at least one must be present at every HAZOP or risk assessment undertaken. The Golden Rule. No Godfather. No HAZOP!

Next, hazards should be understood. Employees must know the nature of the work being done, what the hazards are and how to avoid them. Trite phraseology. What it means is, "You gotta get out there and teach them".

Another point, wherever possible minimise the hazards. Operate using the minimum amount of explosives and limit both the number of persons exposed and their exposure time.

Practice Constant Individual Care. Encourage and nurture good working habits. Always be alert for new hazards and **NEVER** assume that all safety precautions have been taken.

Keep up to date with technology and know the physical and chemical properties of the material you process or work with.

Understand the legislation and how it affects your operations and areas of control.

Keep on top of all handling, transport and waste disposal mechanisms and methods.

Actively seek out and eliminate all spurious sources of ignition.

Walk around, talk to, educate and constantly strive to improve the understanding of the personnel under your control.

And finally, Pay attention to the detail. Pay attention to the detail Pay attention to the detail… Pay attention to the detail… Pay attention to the detail ……..