



Error Management Systems Australia

Red Flag®

A Risk Management System

Error Management

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Red Flag Basics – Error Management Issues

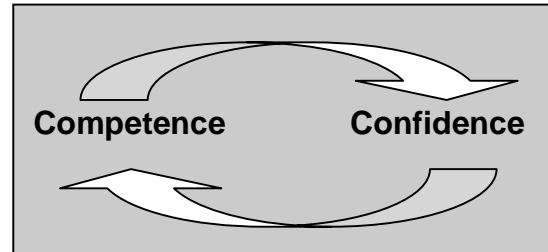
Proven “Error Management Fitness” is a suitable basis for:

- Better conditions for insurance arrangements (personal or professional).
- Employment preference and promotion in safety critical occupations.
 - ◆ Precedents for both exist in aviation.
 - ◆ A sound theoretical base legitimises discrimination.
 - ◆ Objective tests accurately measure “EM Fitness” levels.

Other Examples

Case studies of avoidable disasters, attributable to decision failure, suggest other applications.

- A financier considering a large loan is more secure when borrowers are *EM Fit*.
- People who must perform under stress gain *confidence* from confirmed *EM Competence*.



Fitness

There are many close parallels between EM training and exercising for physical fitness.

- Both involve levels of discomfort, and do not appeal to everyone.
 - ◆ Put it off, there’s always tomorrow ... or perhaps an easier option?
- Once you get into it, though, you join an exclusive club, with tangible advantages.
 - ◆ The harder you work on it, the greater the benefits.
 - ◆ But you have to keep the workouts going, or you will lose fitness.

Rewards aside, there’s real cause for pride in (physical and EM) fitness achievement.

EM Doctrine

While accidents are unavoidable – their number and frequency can be reduced.

- Human error causes most avoidable mishaps.
 - ◆ Getting reality wrong – dangerous state read as *safe* – is the main error.
- EM training reduces individual risk factors.
 - ◆ Judgement is more reliable.
 - ◆ Overall, EM lowers accident rates.
- Some accidents will sneak through defences.
 - ◆ EM Fit people are better equipped to manage after a mishap.

Error Potential

We are all error-prone, to greater or lesser extent.

- Training lowers everyone’s error potential:
 - ◆ *But only if it is specifically and intelligently targeted and diligently*

Space Shuttles

Report into space shuttle Columbia loss notes the same pattern of human error that had been seen and reported in the Challenger accident: *Warning of the defect, passed on by responsible officer, ignored by superiors.*

ENRON, HIH

Hubristic excesses of chiefs plainly to be seen, but government regulators do not intervene.

Canberra Bushfires

Warning after warning – over ten days of fire travel – ignored. Photo in paper shows remains of six burnt houses – and *three full swimming pools nearby.*

undertaken.

Smart Weapons

Precisely mapping the origins of error enables definition of countermeasures.

- Error arises at the moment of decision.
- Chunks of information, at that instant, function as “benchmarks for decision”.
 - ◆ Human information management is skill-based.

Stress Effects

Stress impacts on decision reliability in two ways.

- Stress overload shrinks cognitive capacity and impairs information processing (IP).
 - ◆ In the extreme, “cognitive collapse” obliterates IP ability.
- Denial (information “filtering”) is a normal stress overload avoidance mechanism but ...
 - ◆ ... a hazard when information conveying warning is rejected.

Stress management training is an essential feature of EM courses.

Change Prompt

Decision is an act of choice prompted by information inducing a sense of *need for change*.

- Except in cases of pathological perversity, decision aims to *improve* your status quo.
- That is, the urge to change stems from *dissatisfaction* – you want to make things better.
 - ◆ EM training uses models showing decision functions operating.

Situation Awareness

Perception of the status quo supplies motivation for change.

- In EM doctrine, your sense of present reality is known as *Situation Awareness* (SA).
- Awareness of your situation is the end product of cognitive functions (IP skills).
 - ◆ IP skill functions are demonstrated in EM training using practical models.
 - ◆ EM fitness can be measured through objective test of those skills.

Benchmarks

EM’s training design uses a model that shows information’s role in decision.

- Situation information, as *benchmark for decision*, can be graded as either *soft* or *hard*.
 - ◆ A soft decision benchmark is a *feeling* that change is needed.
 - ◆ The hard benchmark relies on *evidence* – objective measures (eg numbers).

Warnings ignored: (MD-11 & Swissair SR 111)

Swissair flight SR 111, from New York to Zurich, was flown by an MD-11 aircraft ... on

The FAA had received reports that the metalised Mylar – used in the MD-11 as an insulating blanket around, inter alia, critical electrical junctions in the – was flammable. No action was taken.

The insulating material fuelled the fire that caused the aircraft’s loss – and 229 deaths.

The aircraft manufacturer had warned Swissair about the Mylar. Swissair, however, did not treat it as an urgent problem ... as the FAA had not issued a warning.

The ignition source (that caused the Mylar to burn) was a known defect in the insulating material coating the power supply cables themselves.

Emotional Intelligence

Greater use of hard benchmarks for decision promotes “Emotional Intelligence”.

- Alternatively, soft benchmarks generally render decision unreliable.

Decision Stages

Decision is a two-stage operation.

- In Stage 1, information is selected to produce situation awareness (perceived reality).
 - ◆ Rejecting information inhibits accurate appreciation of reality.
 - ◆ EM doctrine identifies Stage 1 as the “Information Decision”.
- In Stage 2, understanding of reality prompts choice according to sense of need.
 - ◆ Stage 2 is the “Action Decision”.
 - ◆ (In managed systems, “sense of dissatisfaction” is known as “error signal”.)

Decision Vulnerability

The two stages of decision define error probabilities.

- Stage 1 Error Management is achieved by strengthening IP skills.
- Stage 2 Error Management is largely the province of professional competencies.

Learning

“Defence against error” attributes are cognitive skills that are acquired through learning.

- Further learning will enable those skills to be strengthened.
 - ◆ Some people are innately less error-prone than others.
- EM training courses offer opportunities to become less error-prone.
 - ◆ Everyone can become less error-prone through training.

Learning Strategy

EM training that you manage yourself will best strengthen accident prevention attributes.

- You learnt your present error defences mainly through trial and error (“heuristics”).
- More of the same will make them stronger – though knowing how and why helps.

Learning Theory

EM courses show you how learning takes place. (It’ll render self-instruction more effective.)

- The *exercise* component of learning improves *error defence* skill fitness.

Warnings ignored: (children at risk)

From: Various news reports

Complaints and expressions of concern had been made – over decades – that a foster family was dreadfully abusing children in their care.

One report was handed, by a fellow parliamentarian (same party), to the Minister responsible.

Years later, the Minister has no recollection of that – or any other – report.

EM Doctrine notes that the unthought (automatic) decision is generally not remembered.

Get really drunk and your ability to (a) establish Situation Awareness and (b) make decisions is impaired.

People who’ve been there can’t remember anything after.

Can’t say why: (QF-1 Bangkok)

From: Case Study x#...

Months after the accident, the 747 captain (he’d set up the runway over-run by reversing a prior decision – from “**Go Around**” – to – “**Land the plane**” – tells a colleague that he can’t recall making the decision – or why he made it.

- ◆ As with physical fitness, it's a clear do-it-yourself" challenge.
- ◆ (No-one can do it for you; reading a book won't get you fitter.)
- *Knowledge learning* – especially the functional models – promotes understanding.
 - ◆ When well enough informed, you will know how to run your own training.

Gaining certainty as to training effect should diminish any apprehension about fitness testing.

Decision's "Muscles'

As noted, decision-making relies on skill-based cognitive competencies.

- Skills are like muscles – you need to exercise them to keep them fit.
- With stronger "decision muscles", you'll get things wrong less often than otherwise.

Fitness

Everyday life supplies skill (and muscle) exercise – delivering "natural" fitness levels.

- If you train regularly, fitness levels improve – to "unnatural" levels.
 - ◆ Stop the extra training and your fitness will revert to natural fitness.
- Strong EM skills are unnatural.
 - ◆ You must train continually to stay at peak fitness.

And, yes, tough physical exercise does contribute to EM fitness as well. They travel together.

Mechanisms

Self-directed EM development produces "fitter" exercise-of-choice mechanisms.

- The result of decision may be action or inaction. (Do something? Yes/No?)
- In either case, the urge to change abates once a plan is decided – either:
 - ◆ Embark on course of action likely to improve grounds for happiness, or,
 - ◆ Accept current plan will continue to maintain enough relative contentment.

Note that the feeling of satisfaction is recorded, not upon achieving the objective of change, but by settling on a plan that will get you there.

- EM's decision models illustrate the key issues in selecting a course of action.

End Result

We all make mistakes, and some people are more error-prone than others ...

- ... but ... *everyone* (you) can train to lower accident risk status.
 - ◆ You'll be more likely to do it there is distinct personal advantage at the end.

Expect from EM training courses that:

- The knowledge element will authenticate the value of the skill training routines.
- Targeted training will deliver higher-than-natural level of error resistance.
 - ◆ You will, through exercise, attain measurably stronger "EM Fitness".
 - ◆ There's a parallel with physical fitness in that exercise must continue.

As everyone learns differently,

- EM fitness workouts involve a D-I-Y diagnosis-prescription-appraisal cycle.
 - ◆ You'll know enough about learning and training design to manage all that.

Theoretical Base

Decision to engage in EM training will arise from your accepting there is cause for discontent with the present state – that your *decision performance can be improved*. It certainly can.

Human decision-making is woefully erratic and unreliable. The idea has been around for a long time. Shakespeare could hardly have written a play but for human folly. And Greek tragedy well and truly pre-dates the Bard. Of more recent provenance:

- *On the Psychology of Military Incompetence* contains chilling stories of classic military blunders and their origins in decision failure. The author is Robert Dixon, the book from his PhD thesis. Formerly a Royal Engineers Major, Dixon went on to become Professor of Psychology at London University. He calls the “bug” common to disasters he analyses, *the ability to tolerate ambiguity*. The key players (military commanders) superimposed a preferred version of reality over the actual truth of the situation they were in. You see the same thing at work in corporate crashes such as HIH and Enron.
 - ◆ In aviation, getting reality wrong is called *Situation Awareness failure*.
 - ◆ Time Management and Information Processing skills form the underlying competencies that produce Situation Awareness.
 - EM training relies on a “working model” for each skill
- There’s more scary stuff in *Essence of Decision*, a study of JFK’s advisors’ decision-making in the Cuban Missile Crisis (Allison). The World poised on the brink of an exchange of nuclear weapons – the end of civilization nigh? – and Allison concludes that the only analytic model that fits all decisions is the participants engaged in a kids’ game of “whose turn is it?” Allison’s background as a Dean of the Harvard Business School and Kennedy insider encourages confidence in both his facts and analysis.
 - ◆ In brief, Allison shows that the essence of decision is irrationality.
 - ◆ *Hard benchmarks* are defences against irrational decision.
- Leaders are often called upon to make important decisions. James MacGregor Burns (another Kennedy insider) wrote *Leadership* – inspired by dismay at Richard Nixon’s recourse to illegality and abuse of presidential power. In one of the most compelling of the hundreds of works on this much examined subject, Burns defines the leader-follower relationship, highlights the need for mutual trust, and notes that an inviolate ethical framework is essential to the relationship working.
 - ◆ EM doctrine promotes ethical behaviour through objective means.
 - ◆ Codified systems of operational rules supply hard benchmarks for decision.
- In my book, *Fit to Fly*, I take up the Dixon thesis. Instead of “tolerance of ambiguity” the more common word “denial” is used. Some people are very resistant to admitting information. (“Closed mind.”) *Reality denial* results inevitably in Situation Awareness failure. “Getting the picture wrong” produces decisions that cause accidents (such as QF1 Bangkok, 23 Sep 99). Case studies allow the reader positively to identify the “deny-reality bug” in operation. A pilot in the grip of denial is clearly a serious hazard in aviation – and EM tests result profiles reveal “carriers” of the bug.
 - ◆ In aviation, folk with extreme denial tendency are called *Rogue Pilots*.
 - ◆ Rogue conduct is often seen in action in other fields (HIH, et al, again).
- *The Opposites Game* is a reference for EM training courses. Its many case studies are examples of dogged perversity in decision-making – maximum denial – and aircraft accidents and needless loss of life that result. While supplying further emphasis to the theme that some people are more likely to act in such ways, *Opposites* also notes the terrible failure of government agencies to prevent more avoidable human error crashes. Indeed, there is evidence that bureaucracies can also catch the rogue bug. It manifests as regulator actions that make accidents *more likely* – quite the opposite to what their government masters intended. The difficulties facing safety watchdogs are not only

seen in aviation, but in corporate collapses, failure to stamp out insider trading, fraud in company governance, dodgy pharmaceuticals sold to the public, price-rigging property scams, market manipulation by stock analysts, etc, etc, etc.

- ◆ Self-regulation is more likely to prevent accidents than a government body.
- ◆ Voluntary adoption of a self-enforcing ethical code attracts respect.
- Another reference for EM training briefly outlines William Powers' theory that Situation Awareness is a cognitive state achieved through two discrete skills – Information Processing (IP) and Time Management (TM). The latter should (though more awkwardly) be known as “Time-To-Attention Management” – as it describes the function of *attention direction*. The obvious example of TM is when you look at something to acquire information as to your present situation, and for *how long* you dwell on the information source, before looking elsewhere. The IP skill operates to enable *recognition* of the objects that, to continue the example, come into your visual field. Visual illusions (they are common in aviation) are examples of faulty IP. The models show both skills at work, in a variety of situations, and thus enable you to understand how to augment their (the models') safety potential in your life and work.
 - ◆ Cognitive and physical skills are the same, in that exercise strengthens them.
 - ◆ A sound grasp of Learning theory enables do-it-yourself exercising.
- Having established that IP and TM skills function to produce your sense of *awareness*, and that perceived grounds for dissatisfaction prompt decision, it's possible to construct another model that demonstrates information's role as “decision benchmark”. As noted, EM doctrine defines decision cues that are based on *feeling* as soft benchmarks (emotion-based). *Hard benchmarks* for decision are objective points of reference, preferably numbers. (Hard benchmarks are also the basis of Emotional Intelligence).
 - ◆ Decisions that rely on hard benchmarks are infinitely more reliable.
- Writers such as Antonio Damasio authenticate the *soft-vs-hard* benchmark concept and highlight the dangers inherent in reliance on emotion (*gut feeling*) in decision. His *Descartes' Error*¹ is an enthralling insight into situation awareness (SA) and decision processes – gained from observing people with acquired brain injury. (Damasio and his wife Hannah are neurologists.) Frontal lobe damage diminishes ability to manage emotion. Awareness of reality is inhibited. Any sense of dissatisfaction is thus rendered transient. It arises – then is instantly extinguished. These people are chronic ditherers, barely capable of choice. *Robotic behaviour* is a corresponding phenomenon (making decisions without being aware of it). We'd never get through life without automated (robot) actions (skills such as walking). And unconsidered, spontaneous, decision-making is a vital component of automated skill performance. Case studies reveal, however, *unconsidered* decision as the most common human error accident cause. Decisions that rely on hard benchmarks cannot be taken automatically. *Considered* decisions, of course, take time – but are quicker when your *EM Fitness* is strong.
 - ◆ Emotion is a soft benchmark for decision and therefore generally unreliable.
 - Judgement can be “calibrated”, but spontaneous decision is still risky.
 - ◆ Using hard benchmarks is time-costly, but less so when the functions are well-exercised (eg, reading an instrument).
- An important EM training reference is a booklet on *Learning*. Working with a victim of acquired brain injury (hence the crossover with the Damasio) re-activated an extensive

¹ *What error?* Damasio reckons Descartes got it wrong when he said humans were rational (thinking beings).

training background. It happened when it became obvious that post-stroke rehabilitation was an exercise in learning. Muscle groups no longer responsive to neural control result in parts (in this case, half) of the body being paralysed. “Work around” skills need to be designed and taught, through exercising. And much more. (Diminished emotional control, for example, produces – as well as indecisiveness – rapid and severe mood swings not conducive to learning.) Perhaps the most telling lesson from the rehab ward is that after only a brief period of disuse, skills are lost. (It’s the same problem astronauts face, loss of muscle tone while weightless.) A conclusion can be drawn: *skill fitness is entirely reliant on practice*. Perhaps less obvious is that skill fitness exists at “natural” and “unnatural” levels. As noted, *natural* fitness levels are maintained by the exercise that comes with ordinary everyday life. To get skill fitness to higher levels you need to work out more than that. The parallel with body size is precise. If you go the gym and work hard you’ll develop larger and stronger muscles. Stop the extra exercise and you revert to the size and shape nature gave you – and that daily activity maintains.

- ◆ Strong EM skill fitness levels are *unnatural* and must be constantly exercised.
 - ◆ You’ll need at least 4 serious sessions a week, of 45 minutes or more.
- Error Management competencies are *defences* against error→accident. The term is from Professor James Reason of Manchester University, a major contributor to mishap prevention literature. His best-known model depicts successive barriers to error as slices of cheese. The first slice (defensive shield) is government regulation, the next the company’s safety procedures, structures, manuals and so on. Reason points out that all such barriers can be expected to contain flaws or gaps – holes in the cheese. The “accident trajectory” (red line) is like a probe finding first one gap, then another. The final shield – the last line of defence – will, however, always be a person. Reason wants that shield to have no vulnerable points. That individual’s EM skills must be robust enough to be certain protection against error→disaster.



- ◆ The knowledge factor in EM competencies is important.
 - ◆ Skill fitness is vital.
- The certainty factor in EM’s training is established by Learning theory. As before, the aim is twofold. First, it’s to activate the autodidact – you are trained to be your own trainer. In addition, exploring learning issues as illuminated by Neuroscience – not a common feature in syllabuses – shows you that your EM training design is precise and sure to have effect. That is, if you do the work, you can be confident of results.
 - ◆ There are incidental benefits. Learning science is generic. Higher levels of understanding will enable significant improvement in your sporting skills – even in frustratingly complex activities like golf – and much more in life.
 - ◆ You’ll be a better person, too, and those who count will welcome that.